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SOME FACTORS RELATING TO THE ATTRACTION OF MANUFACTURING INDUSTRIES TO THE PROVINCE OF ALBERTA

BY

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A THESIS

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ABSTRACT

The attraction of more manufacturing industry to Alberta is a frequently stressed goal of provincial government policy. It is the purpose of this thesis to study several areas relating to this goal: traditional location theory, the industrial structure of Alberta at present, recent shifts in the locational pattern of industry within Canada, transportation costs, and linkage effects between sectors of the economy within Canada.

It was found that three locational factors were most important in determining the pattern of industrialization in Alberta. These factors were the minimization of transportation costs, the cost savings derived from agglomeration of industry, and the locational factors involved in best serving Canadian and North American markets.

It was concluded that the most fruitful areas for further research were the areas of transportation costs within Canada and the area of linkage effects between sectors of the Canadian economy. Further industrialization of Alberta is largely dependent on the extent to which prospective industry can interact with the existing Alberta industrial structure.

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CHAPTER I

INTRODUCTION

Within Alberta, and within Canada as a whole, there is an increasing awareness of the need to reduce the proportion of employment which is directly dependent on the extraction of natural resources. Further processing of natural resource products, and an increase in the proportion of those employed in secondary and tertiary sectors of the economy are goals now espoused by most politicians.

Purpose

It is the purpose of this thesis to do preliminary work towards one aspect of these goals; the attraction of secondary manufacturing industry to Alberta. This preliminary work consists of broadly describing the present industrial structure of Alberta as well as some of the factors affecting the location of further industry in this province.

Scope

It is well to deliniate the ground to be covered by this study in two directions. First, we are concerned here largely with the attraction of manufacturing industry to the Province of Alberta. It is often necessary to deal with the whole of Canada either because we refer to Alberta relative to other parts of Canada or because in some fashion the development of manufacturing industry in Canada implies the development of manufacturing

industry in Alberta, nonetheless Alberta is the primary area of concern.

Second, we should define what we mean by industrialization. At one extreme industrialization may be taken to mean the development of any production other than agricultural production. At the other extreme some may feel an area is not industrialized unless it produces steel or capital goods.[1]

We can roughly divide industrial activity of society into three parts; primary, secondary and tertiary production. Primary production includes the products of agriculture and mining. Secondary production comprised manufacturing and the construction industry. Finally tertiary industry consists of the service industries such as transportation, communications, trade and government.[2] For purposes of this study industrialization is taken to mean manufacturing industries as defined by the Dominion Bureau of Statistics.[3] A listing of manufacturing industries as

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[1] Douglas C. North "Location Theory and Regional Economic Growth," Journal of Political Economy, LXIII (June, 1955), p. 243-58.

[2] Charles P. Kindleberger, Economic Development (2d. edition; Toronto: McGraw-Hill Book Co., 1965) p. 171.

[3] Canada, Dominion Bureau of Statistics, Standard Industrial Classification Manual, 1970, p. 47.

specified by the Dominion Bureau of Statistics is included as Appendix A. Often then when the term industry is used this should be taken to mean secondary or manufacturing industry.

It can be noted that the manufacturing industries can be further broken down into primary-manufacturing and secondary-manufacturing segments. A primary-manufacturing industry is one in which at least 50 percent of the total value of material inputs is from the primary sector of the economy.[4] This work is concerned with both of these segments of the manufacturing industries.

It is also worthwhile at this point to make clear one other very strong limitation of this undertaking. A work the length of this thesis could be undertaken on the prospects for any one of the industries listed in Appendix A being successful with the choice of a plant location in Alberta. It is obvious, then, that in this study only very general statements about the prospects for success for a specific industry can be made. Instead, attention is being focused upon the more general overall locational trends. These trends, it might be hoped, could be used as a basis for more intensive later study of specific industries.

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[4] Bruce W. Wilkinson, Canada's International Trade: An Analysis of Recent Trends and Patterns (Montreal: The Private Planning Association of Canada, 1967) p. 94.

Format

Prior to entering into the main work of this thesis it is felt worthwhile to make some comment on the goal of the attraction of more secondary industry to the Province of Alberta. These comments are contained in Chapter II. Chapter III consists of a brief review or summary of the theory relating to the growth of a specific region and the optimal location for an industrial plant. This core of theory is useful for discussion of the work done in the remaining chapters.

The following three chapters relate to empirical work on the industrialization process of Alberta. Chapter IV deals with the existing industrial structure in the province and how this structure has been changing recently. Chapters V and VI deal with the two locational factors which would seem, from the work of Chapter IV, to be the most important for Alberta. Chapter V deals with the existing freight rate structure and Chapter VI with the linkage effects which stem from our existing industrial structure. From all of this work conclusions are drawn in the final chapter about areas where further work would be most fruitful.

CHAPTER II

INDUSTRIALIZATION AS A GOAL

Before beginning the main work of this thesis it is well to undertake a brief look at the goal of increased industrialization for our province. Until quite recently increased industrialization has been regarded as unbridled good fortune. This is now, in an era of increased awareness of such problems as pollution, not so clearly the case.

Traditionally increased industrialization has been regarded as bringing a higher standard of living for the citizens of the region industrialized. This is the case for two reasons. First increased industry implies increased capital equipment in the region concerned, with the result that each unit of labour, having more capital to work with, produces more and thus can share in a higher standard of living. The second reason, associated with the first, is the implicit feeling that the new industry will incorporate a higher level of technology and thus, as with increased capital, output per unit of labour will go up and a higher standard of living will be attainable.

We should be aware that the attainment of a higher standard of living is dependent on some assumptions. If there are unemployed units of labour then employing this labour will increase the standard of living. If there is no unemployment however, then an increase in the per capita income is dependent on providing more productive jobs for

some of those already employed. In practical terms then there is a necessity for some caution with regard to what type of industry is attracted to a region. A traditionally poor paying industry, such as the garment industry, may in fact not provide for a higher standard of living for the people of the region concerned unless it employs otherwise unemployed labour.

A second reason for attempting to increase the number of industries in a region is to create a more equal distribution of income over some area of concern. Several comments can be made here. The attraction of an industry to Alberta, instead of for example Saskatchewan, may well serve to create a less even distribution of income within Canada. This assumes, as mentioned in the preceding paragraph, that increased industrialization does lead to a higher standard of living. If our area of concern is the province of Alberta, policies designed to attract industry may well bring increased industrialization to those areas already industrialized, thus serving only to accent the unequal distribution of income within the province. We can note therefore that government officials devising policies to attract investment should keep this problem in mind such that the poorer regions of the province be considered.

Another reason sometimes cited for increasing the amount of industry in the province is the desire to "desensitize" the economy to one economic force or another. The markets of agricultural products for example are subject

to the policies and weather of other countries. The supply of these products is subject to our own weather conditions. At the moment the growth of the petroleum industry in Alberta is very much subject to the policy of the American government. The construction industry is very much subject to seasonal fluctuation. It is felt, then, that even if new industry is also subject to some fluctuation, a greater diversity of industry will give rise to a more even rate of economic activity as the fluctuations of one industry may well be dampened by the fluctuations of another. Whether this in fact would be the case would be a matter for some empirical investigation. Whatever the case, if one of the goals of attempting to attract industry is to desensitize the regional economy to various types of fluctuation some attention must be paid to the type of industry attracted.

Another area to be looked at briefly before entering the main work of this thesis is the area of the divergence between social and private costs in the production of goods. This is an area which has received a great amount of discussion in recent years and is, as a result, one of which there is an increasing awareness.[1] While much can be said on the subject, it will be dealt with only very briefly here. It is becoming increasingly evident that some industries in the production of goods use more "factors

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[1] See for example
E.J. Mishan, The Costs of Economic Growth (Middlesex: Penguin Books Ltd, 1967), pp.73-143.

of production" than they are forced by our social organization to pay for. This is the case, for example, when a company pollutes air or water during the production process. In this case some of the costs of production are being borne by those who later use the water or the air in some way, rather than by those who make final use of the good produced. In efforts to attract industry to the province or to a local area consideration must be given to this matter. There would appear to be a great amount of temptation to attract industry by relaxing those constraints which might normally be used to insure that a reasonable portion of all social costs are borne by the private manufacturer. This temptation would seem to result from the fact that it is politically much more popular to allow concessions with regard to externalities than it would be to provide a direct subsidy of the equivalent value to the manufacturer. In efforts to attract industry to an area, then, some effort should be made to assess the total impact rather than just the amount of employment resulting. It will be admitted immediately that this assessment is a very difficult one to make accurately, nonetheless more consideration should be given to this matter.

A "trade-off" between the development of secondary or manufacturing industries and the development of the tertiary sector of the economy is closely related to the above point. It is likely that the development of some forms of primary or secondary industry would interfere with the development of, for example, the tourist industry in

Alberta. While it is not the subject of this thesis the development of the tertiary sector of the economy is certainly important for the Province of Alberta, thus this "trade-off" should be considered by policy makers.

CHAPTER III

REGIONAL GROWTH AND LOCATION THEORY

In this chapter we will put forth a framework of theory within which the Alberta experience of industrialization can later be discussed. Two main bodies of theory will be dealt with and the connection will be made between them as well as possible. The first area to be dealt with is made up of theories of regional economic growth. The next section of this chapter will deal with the theory relating to the location of specific plants.

Regional Economic Growth

The traditional theory of regional economic growth is based upon observation of the development of regions within the European economy. We can call this theory as outlined here the "Stages" theory of regional economic growth. The sequence of developmental stages may be summarized as follows:[1]

(1) The initial stage of economic history for most regions is a self-sufficient subsistence economy with little trade or investment.

(2) As transportation improves the region develops some trade and begins some local specialization. An industrial sector begins to build up to serve the basic

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[1] Douglas C. North, "Location Theory and Regional Economic Growth," Journal of Political Economy, LXIII (June, 1955), p. 244-245.

agricultural population.

(3) With the increase in trade, the region moves towards more specialized agricultural crops such as cereal production or dairy farming. Other extractive industries also become more important as trade grows.

(4) With increased population returns to agriculture and other extractive industries begin to decrease. As this happens the region is forced to industrialize further. The region becomes increasingly dependent upon the production of manufactured goods.

(5) In the final stage of regional growth the region specializes in the export of highly manufactured products as well as capital, skilled personnel and other special services.

North's Theory of Regional Growth

North[2] is critical of the application of the Stages theory to the development of regions in North America. He points out that the North American experience has not followed the stages outlined above. North therefore proposes a somewhat different model for the development of North American regions.[3]

Regions of North America, and this would seem to apply particularly in the case of Alberta, were settled in

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[2] Ibid, p. 245.

[3] We might note that some of North's work is based on work by Harold Innis. See for example The Fur Trade In Canada (New Haven: Yale University Press, 1920).

order to meet a demand for some commodity stemming from outside the region. Growth in the new regions of North America has been in response to the development of "exportable commodities".[4] The development of exportable commodities reflects "a comparative advantage in relative costs of production including transfer costs."[5] Initial phases of growth are concerned with lowering transportation and processing costs for the exportable commodity. Demand for the commodity is largely exogenous to the region and thus less easily influenced. Improvements in technology and increases in social overhead capital, transportation facilities for example, make the exportable commodity more competitive on world markets and thus give rise to increased production of the commodity. This increased production in turn gives rise to external economies making the commodity even more competitive. These developments serve to make the region increasingly dependent on the exportable commodity.

In North's theory this exportable commodity base provides income to the region which in turn gives rise to demand for many types of goods. This demand then can give rise to some residentiary industry to supply local needs. The extent to which residentiary industry will develop depends on competition from imports to the region. The

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[4] The term "exportable commodity"is used by North to describe those commodities, whether they are provided by the primary, secondary, or tertiary segment of the regional economy, which are exported beyond the region.

[5] North, p. 248.

competitiveness of imports in turn depends to some extent on the cost of transportation into the region. North points out in a different article[6] that as transportation has been built primarily to serve the shipment of goods out of the region the inward trip is often made empty. Thus because of joint costs, freight rates into a region of the sort described here might be very low.

Other types of industry will also develop around the exportable commodity base; material oriented industries which use the exportable commodity as an input and market oriented industries which supply the exportable commodity industry. As above, the extent to which these industries develop will depend on the structure of transportation costs.

As the economy develops there will come into existence increased amounts of social overhead capital. This factor, as well as economies of scale and external economies, will perhaps allow the three types of industries which have formed around the exportable commodities base; residentiary industries, industries servicing the export base industry and materials oriented industry, to themselves begin exporting. This will provide a larger base of exportable commodities.

Other types of industry which may develop are those which are "footloose". The likelihood of this type of industry developing in a region increases with the amount of

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[6] Douglas C. North, "Agriculture in Regional Economic Growth" Journal of Farm Economics, 41 (1959), pp. 943-51.

resident capital. As the opportunity for capital in the industries directly related to the exportable commodities base diminishes some of "the accumulated capital will tend to overflow into other activity."

The Stages and the North theories of regional economic growth provide us with a framework within which we can think of the growth, and the industrialization, of the province of Alberta. Interwoven through these theories is the theory of why the micro-economic units, the individual firms, make the decision to locate or expand their plants in the region of concern. We must remember that it is with the decisions of individual firms to locate their plants in a region that economic growth for the region occurs. We will turn now, then, to the traditional theory of why firms locate their plants where they do.

Location Theory

The attractiveness of Alberta for manufacturing industries is derived from the extent to which Alberta is a more profitable location for these industries than other alternatives. To deal further with what factors make Alberta an attractive location for manufacturing industry it is necessary to look at some length at the theory of why industries locate where they do. The theory of optimal location is rather difficult to put forward neatly because of the number of factors which must be taken into account. Perhaps this is why economic theory, at least in England

and North America, has traditionally dealt chiefly with time rather than space.[7] In this case, with a view towards simplifying the discussion of location theory as much as possible, we will deal with each of the most important locational factors separately and in turn. It is well to remember, however, that in making locational decisions firms should take all economic factors into account. The locational decisions of other firms might also have an effect on the optimal location for the firm concerned.

We might interject here a comment on general, as opposed to partial, equilibrium approaches to location theory. Normally firms making locational decisions work in a partial equilibrium world in the same sense as we deal with the cost curves of only one firm in micro-economic theory. A general equilibrium model of location however emphasizes the interrelationships between firms, industries, and potential locations. Thus a change in one aspect of the model, the availability of a factor of production for example,will work through the system possibly making a number of changes in optimal location for even industries which do not use the factor of production which was originally directly changed. A summary of some methods of dealing with this general equilibrium problem is contained in an article by Leon N. Moses entitled

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[7] Walter Isard, Location and Space-Economy, (New York: The Technology Press of Massachusets Institute of Technology and John Wiley and Sons Inc. 1960) p. 24.

"The General Equilibrium Approach."[8]

The purpose to be dealt with here is not how best to take all locational factors into account simultaneously but rather just to deal with what these locational factors are. We shall deal with these factors under six headings; 1) Transportation costs, 2) Labour costs, 3) Agglomerative and deglomerative factors, 4) Other cost factors, 5) Market factors, and 6) The Availability of skilled labour, taxation, local cooperation and personal factors.[9]

Transportation Costs

Transportation costs have been the locational factor which has traditionally received the most attention. This is due, at least in part, to three factors; first it is an area that with certain simplifying assumptions can be made theoretically neat, second it was perhaps the most important element of location theory at the time much of the classical work was done.[10] Finally, and not unrelated to the first two reasons, many of the empirical studies done deal with industries in which transportation plays a large role.

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[8] Leon N. Moses, "The General Equilibrium Approach,"Spatial Economic Theory, ed. Robert D. Dean, William H. Leahy, David L. McKee (New York: The Free Press, 1970) p. 15-29.

[9] Throughout much of this chapter I will rely heavily upon a thesis as follows: Ingrid A. Bryan, "An Economic Critique of Swedish Industrial Location Policy" (unpublished Master's dissertation, Faculty of Graduate Studies, University of Alberta, 1968) p. 28-53.

[10] See for example Alfred Weber, Alfred Weber's Theory of the Location of Industries, translated with an Introduction and Notes by C.J. Friedrich.

The classical work on the transportation cost elements of location theory was developed by Alfred Weber[11] and we will start by dealing with his theory on this subject. Several assumptions and definitions are necessary in order to develop the theory. First Weber assumed that all other cost factors involved in the choice between locations are equal.[12] There is no incentive, therefore, for an industry to choose location A over location B because of some factor not directly related to the costs of transportation. A second assumption, involving some definition, is that all transportation costs can be expressed as functions of only the weight of the good and the distance the good is to be shipped. It is recognized that rates do in fact vary with factors other than these two variables; with the difficulty of the terrain for example. The problem of a variance in rates resulting from rail conditions is solved by Weber by using a distance in his calculations which is greater (or less) than the true distance according to the proportion the rate is greater (or less) than the normal rate. It might clarify to quote from the translation of Weber's work:

> "...If, for example, on certain lines a one-and-a-half rate per ton-mile is collected instead of the normal rate of one, such lines should be regarded as one-and-a-half times as long as they really are in applying to

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[11] Ibid.

[12] Ibid. p. 41.

> them a theory of location which assumes uniform rates.[13]

Weber also recognized that rates vary not just with the weight of the shipment concerned but also with its bulk, its value, or the fact that each shipment uses only, for example, a half-carload. This problem is solved in much the same way as was the problem of the varying rates over equivalent distances. Here we introduce the concept of the "ideal weight" of the shipment. To again use Weber's explanation:

> "...those goods which are charged higher rates because they are shipped in small quantities can be regarded as possessing an ideal weight in addition to the real weight. For instance, if the normal rate for full carloads is 6 cents, the rate for half-carloads 6.7 cents, and the rate for parcels, 11 cents, goods not shipped in full carloads may be regarded as having an additional "ideal" weight amounting to 11 percent and 83.3 percent respectively of their real weight. Similarly, the weight of goods shipped on special reduced rates may be thought of as being reduced in proportion to the reduction in rates.[14]

Two other assumptions used by Weber are; first, the locations and sizes of the places of consumption of each kind of production as well as the locations of the available materials are given and, second, that each product is produced in one stage of production.

Finally, it is necessary to discuss the inputs to the production process. Two types of inputs were put forth by Weber as being necessary; ubiquities and localized raw

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[13] Ibid. p. 43.

[14] Ibid. p. 44-45.

materials. Ubiquities are materials available at any and all of the possible places of production. Air is perhaps the best example of this. Localized raw materials, on the other hand, are those inputs necessary for production which are available only at certain places. It is these inputs, then, which must be transported if production takes place away from the spot where they are available.

Using these two concepts Weber developed two indices which give some indication of where the best location, from the point of view of minimizing transportation cost, is. The "materials index", the first of these measures, is the ratio of the weight of localized raw materials to the final weight of the product. If this ratio is greater than 1 the implication is that the localized raw materials used are "weight losing" in the production process. Thus, if production takes place at the site of the localized raw materials less weight will have to be shipped to the market place than if production took place at the market. If the materials index is less than 1, possible because of the use of ubiquities in production, the amount of weight to be shipped is minimized by locating production at the market place. In the case of a materials index of 1 location of production at least in theory, is indifferent between the raw materials source and the market. In practice however, because raw materials are usually cheaper to ship than final goods, the cases where the materials index is 1 are lumped with those where the index is less than 1.

The second index developed is that of the "locational weight". This is the ratio of the total weight to be moved (the sum of the weights of the localized raw materials the final product) per unit of product weight. As can be seen the locational weight and the materials index are related such that if the materials index is less than one the locational weight is less than two and thus production might be expected to take place at the market. The same correspondence appears from a materials index of greater than one.

We can see that while these indices are useful they are not able to cope with cases where there is more than one raw material source. A method is required for coping with somewhat more realistic locational problems.

To deal with this problem Weber developed a system of locational figures such as lines, triangles and polygons. A locational triangle, for example would include two raw material sources and a market place. To each of the vertices is attached the weight, including the ideal weight, of the raw materials or the final product as the case may be. From the locational figure with the attached weights the minimum transport cost location can be calculated mathematically or geometrically.[15]

Two fundamental problems exist with Weber's analysis which were pointed out by Isard.[16] In some cases rates

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[15] See Weber p. 53-61 and 227-252.

[16] Isard, Location and Space Economy, p. 109.

per ton-mile vary with the distance shipped i.e. the marginal cost of a ton-mile differs from the average cost of a ton-mile. Weber suggested that this be taken into account by varying the distance, by making the distance somehow in proportion to the decreasing rate scale. This however does not work. To quote Isard:

> ...how can we know how much to shorten the distance of any corner of the locational polygon from the given site of production and thus be able to calculate the relative distances between the various corners of the locational polygon until the actual location of the production site is determined; whilst on the other hand the very location of the production site is dependent upon the relative distances between the various corners of the locational polygon.[17]

Closely related to the above problem is the question of loading or terminal charges. In answer to these criticisms Isard develops a somewhat more complex procedure than that of Weber. It is not felt necessary to deal with this here as it is very clearly laid out in the book Location and Space Economy.[18] It is enough to say that the procedure is a modification of Weber's method and uses Weber's locational figures in a more sophisticated fashion such that the criticisms above are taken care of.

It is worthwhile here to stress the importance of terminal and loading charges in location theory. These charges can, especially when the geographical area being dealt with is quite small, be a major portion of shipping

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[17] Ibid.

[18] Ibid. p. 95-112.

costs. As well, while our theory so far has assumed it to be the case, markets are seldomly single points in space. Thus often a new form of transportation is necessary for distribution of goods within the market area. It is often the case, using Isard's analysis,[19] that industry will minimize transportation costs by locating at the point where the terminal and loading charges occur. Thus, for example, we see that a very large amount of North American industrialization occurs where port facilities are available.

It remains to make some comment with regard to the empirical relevance of this theory. A number of studies are cited by Bryan in her work on Swedish location theory.[20] The conclusion reached on the basis of the studies cited "is that transport cost is an important factor in influencing the location of the production site for relatively few industries, notably where transport constitutes a large share of the relative production costs."[21] The materials index is particularly lacking with regard to production costs in that costs of production which do not have direct effect on the weight of the good or raw materials used are not taken into account. Use of large amounts of labour or energy for example could have no effect with regards to weight and yet reduce transportation costs to a very small

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[19] Ibid. p. 110.

[20] Bryan, An Economic Critique of Swedish Location Policy, p.34-41.

[21] Ibid. p. 40.

proportion of the overall production-distribution costs. This sort of criticism is becoming more relevant as improved transportation and distribution facilities lower transportation costs and as improved production methods decrease the amount of raw materials necessary per unit of output. We can say then that firms may be quite insensitive to those factors which make up the materials index if transportation costs are only a small proportion of overall production costs. It should be noted however that, for obvious reasons, transportation cost is a much more important locational factor within Canada than in most other industrialized nations. Thus assessments of the effects of transportation costs an industrial location for countries such as Sweden or Germany may underestimate the effects for Canada.

This comment leads to the possibility of categorizing industries as either "transport oriented" or "footloose" industries. Footloose industries are those for which transportation costs, either of final goods or raw materials, are not significant. Firms producing sophisticated electronic equipment, for example, produce a product which is light and thus inexpensive to ship and yet which has a high value. This type of industry would locate according to criteria other than transportation cost. Transport oriented industries are those industries for which the cost of transportation does play a significant role in their locational decision. Transport oriented industries can be further divided into two categories; market oriented industries and input oriented

ones. This division can be done on the basis of the materials index; those industries with a materials index of less than or equal to one being market oriented and the rest raw materials oriented. Alberta, and all of Canada, have a particularly large share of raw materials oriented industry as we might expect.

We can conclude by summarizing the above points. Some industries, the footloose industries, are insensitive to the costs of transportation. Others are more sensitive to these costs and methods exist for calculating the optimal location in terms of minimizing transportation costs. It may well be, however, that the cost variance between locations is not sufficient to counteract other cost variances to be discussed.

Labour Costs

It is obvious that if there are sufficient savings to be made as a result of lower labour costs a firm will locate at other than the point of minimum transportation cost. This is most true of footloose industries as transportation costs are not significant to their locational decision in any case.

Several concepts were developed by Weber in order to clarify and quantify the results of unequal labour costs between possible locations. The first of these is the concept of isodapanes.[22] Isodapanes are lines connecting points of

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[22] Weber, Alfred Weber's Theory of the Location of Industries, p. 102-104.

equal cost deviation from the point of minimum transportation cost in much the same way as isoquants represent the possible input mixes required to produce a given quantity of output in standard micro-economic theory. It is possible then, to draw an isodapane through any point offering lower labour costs than the location of minimum transportation cost. If the cost deviation, in terms of extra transport costs, represented by the isodapane is greater than the saving in labour costs it would not pay the firm to change to the lower labour cost location. This technique can be used for each location presenting lower labour costs than the point of minimum transportation cost. It is interesting to note a theoretical distinction between labour cost differences and transportation cost differences. In moving between a point of low transportation costs and a point of higher transportation costs there is a continuance of cost levels in between. This is not the case with regard to labour costs. In other words, moving closer to the location of lower labour costs may do nothing towards lowering costs as the area around the location of low labour costs may in fact be a higher cost area.[23]

Two other concepts for dealing with labour cost differences between locations were also introduced by Weber. The first of these is the "index of labour costs" which is the cost of labour per unit of output. This measure is an indication of the amount of labour costs per ton of product,

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[23] Ibid. p. 102.

or in other words per ton of product which would have to be moved as a result of a movement away from the minimum transport cost spot. The greater the index of labour costs the more likely is it to be profitable for the entrepreneur to locate his factory at a point of lower labour cost than the minimum transport cost location.

It might be recognized that this measure is somewhat inexact in that the weight of the final product may not bear too much relation to the extra transport costs arising from a move away from the minimum transport cost spot. This would be the case, for example, if production involved weight losing raw materials. By relating the "index of labour costs" and the "locational weight", a measure discussed under transportation costs, we can arrive at a better measure of the likelihood of a locational change to a lower labour cost location from the minimum transport cost spot. This new measure is the "labour coefficient" and can be defined as follows:[24]

$$\text{Labour coefficient} = \frac{\text{index of labour costs}}{\text{locational weight}}$$

$$= \frac{\dfrac{\text{cost of labour}}{\text{unit of product weight}}}{\dfrac{\text{total weight to be moved}}{\text{unit of product weight}}} = \frac{\text{cost of labour}}{\text{total weight to be moved}}$$

$$= \frac{\text{labour cost per ton of product}}{\text{tons of weight to be moved per ton of product}}$$

It can be seen, then, that the greater the labour coefficient the more likely is the firm to choose a site which

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[24] *Ibid*. p. 111.

offers lower labour costs than the minimum transportation cost site.

We have then a theoretical relationship which allows us to interrelate the cost changes resulting from transportation costs and differences in labour costs between two locations. For the remaining cost factors it will often not be so easy to put forth such relationships. This is the case in the next area of locational factors to be discussed.

Agglomerative and Deglomerative Factors

It is unfortunate that it is very much more difficult to deal with the factors under the heading of agglomeration than it was to deal with transportation and labour costs. While we can have some success describing what sort of things cause the agglomeration of industry we can have very little success quantifying these forces for reasons which should become clear in the discussion of these factors. It would appear that in our problem of attracting industry to Alberta major forces which must be counteracted are those relating to the agglomeration economies offered by the area already most industrialized, southern Ontario and industrialized Quebec.

Isard, in an extension of Weber's basic work, classifies agglomeration factors as follows:

(a) Large-Scale economies within a firm, consequent upon the enlargement of the firm's scale of production at one point.

(b) Localization economies for all firms in a single industry at a single location, consequent upon the enlargement of the total output of that industry at that location.

(c) Urbanization economies for all firms in all industries at a single location, consequent upon the enlargement of the total economic size (population, income, output, or wealth) of that location, for all industries taken together. 25

The first of these classifications, large scale economies within a firm, relates very closely to traditional micro-economic theory of the firm. If, for example, a market is being served from two points within the market area it may well be that the increased economies of scale in production which occur from having only one production point will outway the increased transportation costs involved. If this is the case then production will tend to agglomerate at one spot. If the opposite is the case, economies of scale do not outweigh transportation costs, then the tendency is towards deglomeration. We can certainly see this process occurring in Canada. Automobile production, at one extreme, is centered in one part of Canada because economies of scale justify production in one spot for all of Canada.[26] Bakeries, at the other extreme, are spread throughout Canada, existing not just in each city but almost in each neighbourhood.

Localization economies occur when it profits firms within an industry to locate in one place. This might be

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[25] Isard, Location and Space-Economy, p. 172.

[26] The Auto Trade Pact of 1965 has now perhaps made this point a historical one.

the case, for example, if the existence of several firms in one place allows the economic existence of some service industry which lower the costs of the several firms. These "external economies" then give rise to the agglomeration of firms in one location.[27]

Urbanization economies arise from the growth of the whole urban area, not just the growth of one firm or one industry as in the two previous classifications. There are, for example, economies of scale involved in the production of many of the services necessary for an urban environment. The provision of ecudation, sewer and water facilities and electricity are examples of this. Diseconomies, giving rise to a tendency towards deglomeration, might also occur. In larger cities we may well reach the area of rising costs in providing the above services. Transportation is often a very great problem, and expense as urban areas grow.

Economies presented by locating in an "area of agglomeration" can be taken into account, to the extent they are measurable, in much the same way as could the benefits of lower labour costs, by the use of isodapanes.

Other Cost Factors

Several other factors of production which may affect location will be looked at briefly here. The first

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[27] An excellent article on the organization of production with these sort of external economics in mind is: George J. Stigler, "The Division of Labor is Limited by the Extent of the Market", Readings in Microeconomics, ed. William Breit and Harold M. Hoehman (Toronto: Holt, Rinehart and Winston, Inc., 1968) p. 151-160.

of these is the availability of energy such as coal, natural gas or electric power. The effect of the availability of these factors should be derivable using the theory developed for finding the optimal location with respect to transportation costs. Two aspects might be considered here. First, power is totally weight losing; thus if production is done at the source of power there will be no transportation costs resulting from the use of the power. Second, the transmission of electric power over long distances involves considerable loss and thus can be quite expensive. The availability of power can therefore, have an effect on the optimal location of some industries, especially those for which power, or energy is a more important input. The location of the Aluminium smelting industry in Kitimat is a classic example of this.

The availability of capital might well have an effect on the optimal location of an industry. We here can made a distinction between capital goods and equipment and monetary capital. There is a very great difference in mobility between the two types of capital. There is, as a result, a difference between the ease of attracting an already established firm, with a large investment in capital equipment, and attracting a new firm which does not have capital equipment to a new location.[28] We can assume that within Canada monetary capital is sufficiently mobile that

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[28] E. Willard Miller, A Geography of Industrial Location (Dubuque, Iowa, Wm. C. Brown Co., 1970) p. 31.

the availability of this factor is not important in establishing the optimal location of a new plant.

Rent is a locational factor we might also consider. High rent for land within an area, caused perhaps by the land having great value for some competing use, may force an industry to some other area.[29] This locational factor perhaps has more significance with respect to choosing the best location from amongst a set of very small areas than in, say, choosing from amongst the provinces of Canada.

Market Factors

Our discussion so far of locational factors has followed closely on the work done by Weber and Isard. Both of these authors placed emphasis on the idea that the optimal location is where costs are minimized. Lösch[30] has been critical of Weber's work because of this one-sided orientation. Much of Weber's work implicitly regards gross revenue as constant, thus there is an implicit assumption that minimizing costs is in fact profit maximizing.[31] Lösch criticizes this implicit assumption and deals with market factors and their effect on optimal location. Lösch also points out that when we include market factors in the analysis it is no longer algebraically or geometrically possible to determine an optimal location.

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[29] Edgard M. Hoover, The Locations of Economic Activity, (Toronto: McGraw-Hill Book Co. Inc., 1948) p. 71-76.

[30] August Lösch, The Economics of Location, translated by William H. Woglom, (New Haven:Yale University Press, 1954) p.27-28.

[31] Ibid. p. 27.

As an example of Lösch's work we might follow through an analysis done by Bryan.[32] We assume that buyers are spread out over a large market area. A number of producers are producing a homogeneous product such that buyers are indifferent between producers. Processing and procurement costs are the same for all locations. Distribution and transportation costs to the market are paid by the consumer. All producers are prepared to sell to the whole market if they could obtain it.

If demand is inelastic, the producer's sales are not influenced by where he locates. If demand is elastic however, producers will spread throughout the market such that distribution costs will be minimized and as a result sales maximized. At the limit a pattern of bounded markets will appear which depend for their shape and size on the distribution of population, the number of producers and the availability of transportation.

Two Swedish studies, one by Törnquist and one by Backland, are cited by Bryan[33] which point out the need for "market contact". It was felt by both of these authors that a firm benefits in terms of increased sales by being located at the market.

We have then another force which tends to move the location of industry towards the market place.

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[32] Bryan, An Economic Critique of Swedish Location Policy,p.47-49.

[33] *Ibid*. p. 49-50.

The Availability of Skilled Labour, Taxation, Local Cooperation and Personal Factors

A number of other factors may affect the optimal location of an industry. We will deal briefly with some of these factors here. The availability of skilled labour is the first of these. To the extent that labour is mobile the skilled labour can be considered much like a raw material i.e. we need only take into account the cost of attracting the skilled labour to any proposed plant location. If skilled labourers are reticent to move, or if a firm requires a variable supply of skilled labour the firm may find very real cost advantages to locating at the supply of the type of skilled labour it needs. Again this factor is one which is exceedingly difficult to quantify. We are left to fall back on the judgement of the entrepreneur with regard to the amount of extra trouble and resulting extra cost he will incur by locating away from the supply of skilled labour.

Two other factors which may have an effect on where a firm might optimally locate are the levels of taxation and the supply of public services in the various possible locations. These factors, as opposed to the supply of skilled labour, are much more easily taken into account by the entrepreneur as direct costs can be attached to the differences.[34]

A final locational factor to be touched upon is the area of personal considerations. It is quite likely,

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[34] Melvin L. Greenhut, Plant Location in Theory and Practice, (Chapel Hill: The University of North Carolina Press, 1956) p. 137-139.

especially in the case of the small firm, that the owner will look no further than his own area for a place to locate. A study done by Roy E. George entitled "The Attraction of Quebec and Ontario for New Manufacturing Industry" in 1965 found the following:[35]

TABLE 1

EXTENT TO WHICH FIRMS CONSIDERED PROVINCES
OTHER THAN THOSE THEY CHOSE
AS SITES FOR NEW PLANTS [a]

	Number of Firms	
No Consideration of Other Provinces	277	(79%)
General Consideration of Other Provinces	55	(16%)
Detailed Examination of Other Provinces	18	(5%)

(a) From Roy E. George, The Attraction of Quebec and Ontario for New Manufacturing Industry, Dalhousie University (Halifax: By the Author, 1966).

While personal considerations need not be the only reason for this lack of interest in researching various alternative plant locations they would seem important.

Conclusions

Concluding comments to this section of the chapter might be made in two general areas. First, it is worthwhile to again stress the interrelatedness of all the locational factors discussed here. This interrelatedness, combined with accounting for locational decisions of other firms,

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[35] Roy E. George, The Attraction of Quebec and Ontario for New Manufacturing Industry, Dalhousie University (Halifax: By the Author, 1966).

must make locational decisions very difficult in many cases. As a result of this difficulty it would seem likely that many locational choices are made with rather incomplete knowledge.

Second, we might point out the number of locational factors causing a tendency for industry to locate in the part of Canada already heavily industrialized, Southern Ontario and South Western Quebec. More than one half of Canada's population live in this area. The area of the United States immediately adjoining this part of Canada also has a large population. Thus by far the largest and most concentrated market for goods produced in Canada lies in this region. We can see, then, that industries which are attracted to the market area by transportation costs will have a tendency to this area. Closely related to this is the fact that much of Canada's industry is already in this area thus any industries which profit from agglomeration economies or need skilled industrial labour might be attracted towards the area already industrialized.

The next stage of this thesis is to try to formulate a view of the existing industrial structure of Canada and particularly Alberta such that we might better reach conclusions about which industries can be attracted to Alberta despite the above factors.

CHAPTER IV

THE STRUCTURE OF CANADIAN INDUSTRIALIZATION

Just as it is necessary to have a background knowledge of location theory for our discussion it is also necessary to have a general knowledge of the structure of manufacturing industry within Canada. Which manufacturing industries are the most important to Alberta and the other regions of Canada? Which manufacturing industries are growing more than proportionately in Alberta and the other regions?

It is proposed to answer the above two questions in this chapter under three main headings. First we will deal with the existing industrialization in Canada by enumarating those industries which are the most important in each province. Next, by using a type of "shift and share" analysis, we will try to describe which manufacturing industries show signs of changes in optimal location within Canada and which provinces are gaining or losing as a result of these changes. The third section will summarize the first two sections, make some comments with regard to the pattern of industrial growth Alberta has experienced and finally draw any available conclusions for the future.

The Important Industries

It is worthwhile to enumerate the most important manufacturing industries in each province. With this information we will have an overall concept of the structure of Canadian manufacturing.

The industries of Alberta listed in Table 2 can be examined in terms of specifying the locational factors which have been important in attracting industry to Alberta. As mentioned in the introductory chapter, we can deal only briefly with each industry here. As a result comments on the reasons for the location of each industry in Alberta are somewhat speculative in nature.

We can divide the industries in Table 2 into three main categories depending on the main locational factors for the industry. The first category and perhaps the most important are those which are tied to the raw materials they need because of a weight loss in processing. These industries are important in that they help make up an export base for the province. In this category we can place slaughtering and meat packing plants, manufacturers of industrial chemicals, dairy factories and petroleum refining. Four other of the industries listed would seem to be located in Alberta at least partly because of the pull of the availability of raw materials. These are the brewing industry, feed manufacturing, flour mills and veneer and plywood mills.

The remaining industries can be divided, at least to some extent, into those which serve the export base industries and those which serve final demand. There is some difficulty in several cases in putting an industry in one category or another as several industries serve the construction industry in general, both in the building

TABLE 2

ALBERTA

SELECTED PRINCIPAL STATISTICS ON TOTAL ACTIVITY OF THE LEADING MANUFACTURING INDUSTRIES RANKED BY TOTAL VALUE ADDED (a) (b)

1967

Rank	Industry	Total Employees	Total value added
1	Slaughtering & meat packing plants	4,582	55,704
2	Manufacturer of industrial chemicals	1,585	51,173
3	Petroleum Refineries	1,027	33,593
4	Dairy factories	2,752	23,114
5	Publishing & printing	1,800	21,094
6	Sash, door & other millwork plants	2,415	20,271
7	Fabricated structural metal industry	1,586	16,351
8	Bakeries	1,774	14,986
9	Breweries	521	14,948
10	Machine shops	1,329	14,195
11	Sawmills & planing mills	1,967	14,040
12	Miscellaneous machinery	907	11,962
13	Metal stamping, pressing & coating industry	901	10,870
14	Concrete products manufacturers	834	10,717
15	Ready-mix concrete manufacturers	626	10,703

(Table 2, continued)

16	Commercial printing	1,144	10,122
17	Feed manufacturers	660	9,350
18	Soft drink manufacturers	779	8,630
19	Truck body & trailer manufacturers	1,100	7,980
20	Steel pipe & tube mills	549	6,550
21	Flour mills	627	6,215
22	Ornamental & architectural metal industry	705	5,780
23	Veneer & plywood mills	547	4,642
24	Agricultural implement industry	489	4,128
25	Miscellaneous wood industries	217	3,926

(a) Canada, Dominion Bureau of Statistics, Manufacturing Industries of Canada, Section E, Prairie Provinces, 1964, (Ottawa: The Queen's Printer, 1968) p. 59.

(b) We note that this table only includes industries to which the confidentiality requirements of the D.B.S. do not apply.

of capital goods and in the building of housing for final demand.

Industries which are market oriented and have as their market other industries are the next category. The fabricated structural metal industry, machine shops, miscellaneous machinery and equipment manufacturers, the metal stamping, pressing and coating industry, concrete products manufacturers, steel pipe and tube mills, the ornamental and architectural metal industry and the agricultural implement industry are all, at least to some extent, in this category. Feed manufacturers are also located here at least partly because of the available market.

Industries which serve the demand for final products, and are located in Alberta primarily because of this demand, are dairy factories, printing and publishing, sash, door and millwork plants, bakeries, breweries, sawmills and planning mills, ready-mix concrete manufacturers, commercial printers, soft drink manufacturers, flour mills and veneer and plywood mills.

Locational Factors drawing Alberta's Main Industries

While we cannot be too specific in stating which locational factor is of most importance in determining the location of each of the above industries, we can abstract from the above the locational factors which have so far contributed most in attracting industry to Alberta.

Two areas are of most concern; transportation costs and market factors. The base industries are located here because they are natural resource oriented when transportation costs are taken into account. Such industries as slaughtering, the chemical industry, and petroleum refining are in this category. Most of the remaining industries are market oriented. Their markets consist either of final demand, or of demand stemming from the other manufacturing industries. Such locational factors as the cost of labour and agglomerative or deglomerative effects do not seem to play much part in locating industry, even though Calgary and Edmonton are now quite large.

One can see then the extent to which the industrialization of Alberta has depended on the existence of petroleum and agricultural land. The four industries slaughtering, industrial chemicals, petroleum refining and dairy factories in 1967 provided for approximately 27 percent of the total value added for all industries. Many of the remaining important industries (as ranked by total value added) exist to supply the necessary equipment for the agricultural and petrochemical industries. Most of the remaining industries exist to serve the final demand of a population which depends for its livelihood on the base industries.

Relative Growth by Province

In the preceding section we have dealt with the existing industrial structure in Canada and particularly Alberta. It is proposed in this section to try to develop some indication of how this structure is shifting between provinces. With this information we should be able to draw some conclusion on what underlying changes are occurring in the basic locational factors.

An increase in the amount of one industry in an area, the province of Alberta for example, can occur for two reasons. First the industry might grow in the country as a whole and by retaining a constant share Alberta will have an increased absolute amount of this industry. Second, by increasing its share of the given industry, the province can also increase the absolute amount of an industry within the province even if the industry is declining in the country as a whole. In this section we will abstract from the overall industrial growth in the various provinces to show which industries showed relative growth. By relative growth we mean an increase in the amount of an industry within a province _above_ the amount which the province would have had had it just retained its share.

The Fuchs Method

The technique used to abstract relative growth from the overall changes in the industrial structure of

each province is one developed by Victor R. Fuchs.[1] It consists of comparing a linear projection of production from a base year to actual production in the year in question.[2] A number of difficulties exist with this method as used here and these should be mentioned. First there is the problem of the choice of the base year. It is possible that the year chosen may reflect some out of the ordinary happening, a bad agricultural year for example. This out of the ordinary occurrence would then be projected forth as the normal state of affairs. A second difficulty of this method lies in the interpretation of the results. There is a danger that a negative value, a number implying that a specific province has not kept its share of the industry concerned, will be regarded as unequivocally bad. It may in fact be that this signifies a movement of the economy towards efficiency,

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[1] Victor R. Fuchs, "Changes in the Location of U.S. Manufacturing since 1929", _Journal of Regional Science_, Vol. 1, no. 2 (Spring, 1959) pp. 1-17.

[2] Let Xij be value in initial year for one industry (i) in one province (j)

Yij be value in terminal year for one industry (i) in one province (j)

then _projected_ value Hij for one industry in one province in the terminal year

$$Hij = \frac{\sum_j Yij}{\sum_j Xij} \cdot Xij$$

thus the comparative gain or loss
= Yij - Hij

= terminal value - projected value

say by centralizing production thus giving rise to economies of scale. It is well then to consider the values we will reach in light of both location theory and the goals we might have for the economy.[3]

Another set of difficulties relate to the collection of the data. Over the period of time chosen, 1952 to 1964, a major revision of the Industrial Classification Manual occurred. In 1960 three new two digit industries were created. As well, the steel industry and electrical production industry were completely restructured. As a result it was impossible to provide a direct comparison back to 1952. An estimate of the 1952 figures was made using the 1957 proportions on the total figure for 1952. A second data problem stemmed from the confidentiality requirements included in the law governing publications by the Dominion Bureau of Statistics. In most cases of this sort, production for the industry concerned was distributed among the provinces on the basis of the number of firms in each province. In the four maritime provinces and Saskatchewan, however, there were so many empty cells that it was felt better to omit these provinces from the study.

It was necessary to make a decision with regard to what indicator of manufacturing activity to use. A number of possibilities exist but the choice was reduced to employment

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[3] Other criticisms of shift and share analysis are given in D.B. Houston, "The Shift and Share Analysis of Regional Growth : A Critique," Southern Economic Journal, XXXIII (April, 1967) pp. 577 - 581.

and value added. Value added was chosen as it "is considered to be the best value measure available for comparing the relative economic importance of manufacturing among industries and geographic areas".[4] It might be noted that Fuchs carried out his work using both value added and employment figures and found that in some cases there was a considerable difference between the two sets of results.[5] The direction of locational change however was clear from either set of figures. For these reasons, and because of the complexity and amount of calculation needed, only value added figures were used.

Using the approach developed by Fuchs we apportion the total value added for a specific industry in the year 1964 to the provinces according to the proportion of that industry in each province in 1952. The figures arrived at are then compared with the actual value added figures for each province and a figure for relative gain or loss is arrived at. An example, along with the necessary arithmetical relationships, is given in Table 3 using total value added for all manufacturing industries.

We can see from this table that Ontario, Alberta and British Columbia made strong relative gains in total manufacturing activity with Quebec being the strong relative loser. These figures are especially significant when viewed as percentages. Ontario grew above the projected growth figure

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[4] Victor R. Fuchs, Journal of Regional Science, Vol. 1, no. 2, p. 4.

[5] *Ibid.*, p. 14-17.

by 2.7% while British Columbia and Alberta were above 10% and 33% respectively. It might be noted at this point the extent to which Ontario and Quebec dominate manufacturing in Canada with 81.5% of the total value added by manufacturing occurring in those two provinces in 1964. The growth in manufacturing in Canada as a whole, then, is really to a very great extent the growth of manufacturing in those two provinces.

The same calculations were done by Ray Norgren for each of the 140 3-digit industrial classifications as found in the Standard Industrial Classification Manual.[6] From these calculations those industries showing the largest comparative gains and losses by province were chosen. The results of this work are summarized in Table 4 and in Tables 13 through 16.

Locational Factors Giving Rise to Alberta Gains and Losses

While it is somewhat speculative to comment on the reasons for shifts in locational preference which have occurred over the 1952-64 period, some comments can be made with respect to Alberta nonetheless. Alberta would seem to be becoming increasingly dependent on basic resources for its expansion in primary and secondary manufacturing. Slaughtering, pulp and paper, glass products, butter and cheese, process cheese and asphalt roofing are all closely tied to the basic resources of the

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[6] Raymond C. Norgren, Unpublished Term Paper, University of Alberta.

TABLE 3

CALCULATION OF RELATIVE GAINS OR LOSSES FOR THE PERIOD 1952-1964 FOR VALUE ADDED OF ALL MANUFACTURING (a)

Province	Value added 1964 $'000	Value added 1952 $'000	Projected values (b)	Comparat Gain or Loss
Newfoundland	82,770	56,109	107,336	-24,566
Prince Edward Is.	12,414	5,957	11,395	+ 1,018
Nova Scotia	218,292	130,715	250,057	-31,765
New Brundwick	198,030	117,837	225,422	-27,392
Quebec	4,125,329	2,288,643	4,378,174	-252,845
Ontario	7,489,116	3,811,106	7,290,645	+194,471
Manitoba	357,272	216,814	414,765	-57,493
Saskatchewan	136,137	80,934	154,826	-18,689
Alberta	454,935	178,221	340,936	+113,999
B.C.	1,170,556	556,172	1,063,957	+106,599
	14,244,851	7,442,508		

(a) Canada, Dominion Bureau of Statistics, Manufacturing Industries of Canada, Section B-F - 1964 (Ottawa: The Queen's Printer, 1968) Sect. B p. 21, 31, 49, 65; Sect. C p. 43; Sect. D p. 43; Sect E p. 35, 51, 75, Sect. F. p. 35.

(b) Growth of all manufacturing in Canada

$$= G = \frac{14,244,851}{7,442,508} = 1.913$$

Projected values = 1.913 X 1952 figures

(c) Comparative gain or loss

= 1964 value added - projected values

TABLE 4

ALBERTA

INDUSTRIES SHOWING THE FIFTEEN LARGEST COMPARATIVE GAINS AND LOSSES

Industries Showing Comparative Gains

Industry	Comparative gain $'000
Slaughtering	12,408
Pulp and paper	11,451
Ornamental iron	6,236
Glass products	6,087
Fabricated structural steel	5,343
Men's clothing	5,209
Butter and cheese	3,986
Rubber industries	3,829
Process cheese	2,909
Machine shops	2,074
Printing and publishing	2,030
Metal stamping	1,940
Asphalt roofing	1,294
Confectionery	1,083
Women's clothing	1,026

Industries Showing Comparative Losses

Industry	Comparative Loss $'000
Petroleum Refineries	5,437
Auto parts and accessories	5,379
Sawmills	3,028
Breweries	2,945
Concrete products	2,755
Sash and door	2,098
Fruit and vegetable canning	1,829
Miscellaneous food	1,509
Aircraft and parts	1,169
Biscuits	1,069
Signs and displays	1,067
Animal oils and fats	833
Miscellaneous metal	705
Wooden box	572
Vegetable oils	525

province. An exception to this trend is Petroleum refining which would seem to be tending to locate closer to the major markets in Ontario. This shift is of note as an example of changes in transportation facilities which lead to changes in the optimal location for an industry. In 1952 it was relatively less expensive to ship the final refined product to the major market area than it was to ship the unrefined crude oil. With the building of pipelines to the east however it became cheaper to ship the crude oil to the market area and do the refining there.

The relative growth in these natural resource based industries might be the result of two locational factors. First it is likely that an optimal level has been reached for these types of industries in the provinces of Ontario and Quebec. The returns, for example, for investment in a pulp and paper mill in Alberta may now be greater, even though costs of transportation are more, than would the returns to an investment in a new mill in Ontario or Quebec. We can see, by looking at tables 14 and 15, that the relative gains made by Alberta and British Columbia in the pulp and paper industry were at the expense of Ontario and Quebec. These same comments can apply to those industries based on agricultural products.

A second locational factor might be the improvement of transportation facilities from Western Canada to Eastern markets. There has undoubtedly been an improvement, for example, in both roads and trucks over the period concerned.

An additional factor, which relates both to the relative gains made in the resource based industries and most of the other industries in which Alberta showed gains, is final demand. If we apply the same sort of calculation to population over the 1952 to 1964 period as we did for the value added by industry we find that Alberta showed a relative gain of 122,000 people. As can be seen by Table 5 British Columbia and Ontario also gained at the expense of Quebec, Saskatchewan and Manitoba. Industries such as printing and publishing and confectionary which are final demand oriented would show a relative gain in Alberta due to the relative gain in population Alberta has shown.

We might also conclude that there is a certain amount of agglomeration occurring in Alberta for the prairie market as a whole. As can be seen by Table 13 Alberta is now the most populous of the three prairie provinces and we might expect that this province will continue to grow more quickly than the other two. Thus it would seem increasingly likely that any firm hoping to serve the whole prairie market from one plant would locate in Alberta. The fact that British Columbia markets are also expanding relatively quickly suggests that a location in Alberta may be favoured over the other two prairie provinces.

While it is more difficult to derive locational factors which have given rise to the relative losses for Alberta, some specific comments can be made. The relative loss of the petroleum refining industry has already been

TABLE 5

COMPARATIVE POPULATION GAIN BY PROVINCE (a)

Province	real 1952 pop. '000	real 1964 pop. '000	predicted 1964 pop. '000	Comparative Gain (+) Loss (-)
Quebec	4,174	5,562	5,637	-75
Ontario	4,766	6,586	6,437	149
Manitoba	798	958	1,078	-120
Saskatchewan	843	943	1,139	-196
Alberta	970	1,432	1,310	122
B.C.	1,198	1,738	1,618	120
	12,749	17,219	17,219	

(a) Canada, Dominion Bureau of Statistics, Canada Year Book - 1966 (Ottawa: The Queen's Printer, 1966) p. 207.

discussed. Other losses to Alberta might also be attributed to better transportation systems and thus reduced transportation costs. As transportation costs become less economies of scale and the external economies of agglomeration might become sufficient for centralization of production to be profitable. We might speculate that this is the case for the auto parts and accessories industry, the brewing industry and the aircraft industry.

We can summarize our speculation on which locational factors have caused the shifts to or from Alberta with Tables 6 and 7. We can see, as was the case in the preceding section, that our relative industrial gains are dependent upon our natural resource base. Most of the industries growing in Alberta relative to the rest of Canada are linked either in a forward or backward direction to the resource base. Those industries which are not gaining for this reason are tied to final demand which in turn derives from the extractive industries and those industries linked to the extractive industries.

Alberta's Position - A Summary

Alberta's position with regard to industrialization might best be put forth using North's[7] theory for the growth of regions in North America as put forth in chapter III.

The typical pattern of economic growth in North America differed from the pattern within the older industrialized

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[7] Douglas C. North "Location Theory and Regional Economic Growth, "Journal of Political Economy,"LXIII (June, 1955), p. 243-58.

TABLE 6

LOCATIONAL CHARACTERISTICS OF INDUSTRIES SHOWING RELATIVE GAINS IN THE PROVINCE OF ALBERTA

Industry	Position on Table 2	Locational factors			
		Natural resource based	Market oriented	Foot loose	Agglomeration
1) Slaughtering	1	X			
2) Pulp and paper	(a)	X			
3) Ornamental Iron	22		X		
4) Glass Products	(a)	X			
5) Fabricated Structural Steel	7		X		X
6) Men's clothing	(a)			X	X
7) Butter and cheese	(a)	X			
8) Rubber industries	(a)	X	X		
9) Process cheese	(a)	X			
10) Machine shops	10		X		
11) Printing and Publishing	5		X		X
12) Metal Stamping	13		X		X
13) Asphalt roofing	(a)				
14) Confectionary	(a)		X		
15) Women's clothing	(a)			X	X

(a) the industry is not among the top 25 industries, ranked by value added, in Alberta.

TABLE 7

LOCATIONAL CHARACTERISTICS OF INDUSTRIES SHOWING RELATIVE LOSSES IN THE PROVINCE OF ALBERTA

Industry	Position on Table 2	Locational factors			
		Natural Resource based	Market oriented	Foot loose	Agglomeration
1) Petroleum	3		X		
2) Auto parts and accessories	(a)				X
3) Sawmills	11	X			
4) Breweries	(a)				X
5) Concrete products	4				
6) Sash and Door	6				X
7) Fruit and Vegetable canning	(a)	X			
8) Misc. Food	(a)				X
9) Aircraft and parts	(a)				X
10) Biscuits	(a)				X

(a) the industry is not among the top 25 industries, ranked by value added, in Alberta.

nations. Regions of North America, and this would seem to apply particularly in the case of Alberta, were settled in order to meet a demand for some commodity stemming from outside the region. Thus Alberta's initial period of settlement was in response to a European demand for furs. The next major influx of population came when it became feasible to export agricultural commodities as a result of completion of the Canadian Pacific Railway. The discovery of petroleum also caused a sizable increase in the population.

The growth of Alberta, then, has been in response to the development of "exportable commodities". With this growth, as North has suggested, came demand for many types of goods both as intermediate goods in the production process and to supply final demand. To some extent, depending on the locational factors of the industries, residentiary industry will form to supply these goods. Industries which are materials oriented and use the export base product as input will also form around the exportable commodity base.

It is, in a general way,easy to see that Alberta fits into this type of model of industrialization.[8] We have an exportable commodity base made up of agricultural products, petroleum products and the wood industry. Around this base we have industries linked either "forwards", those which use the exportable commodities as inputs, or "backwards", those which supply the export commodity industries.

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[8] See Tables 2 and 4.

As well there is a number of prominent market oriented or residentiary industries.

Out of the above comments on the process of industrialization in Alberta come two areas which might be most fruitfully studied more closely. The first of these is the whole area of transportation costs. As we can see from North's work transportation costs are a "double edged sword" with respect to industrialization in Alberta. On one edge the lower are transportation costs the more likely are the export base industries, and those industries depending on the export base for inputs, to be able to compete for markets outside the province. On the other hand, if transportation costs become too low some industrial processes which are now raw materials oriented could become market oriented and thus move out of Alberta. To take an extreme example, if the costs of transportation of either pulp and paper products or logs were reduced to zero it would be most feasible to set up one centre of processing the logs perhaps close to the eastern market area or in an area where the most external economies occurred. This would very likely mean Alberta would lose its pulp and paper manufacturing plants.

In the same view, the higher the costs of transportation the more likely are residentiary industries to form to supply final demand within the region. If, for example, transportation costs into the region are very low it may be impossible for local industry to compete with

imports from other regions. This same reasoning applies to the development of "backward linkages" within the region. The resource base industries demand certain input products, agriculture gives rise to a demand for farm implements for example. The extent to which local industry arises to provide for this demand depends to some extent on the implicit tariff protection of transportation costs.

It is worthwhile then to look at the existing freight rate structure to see if any conclusions can be drawn with respect to the implications of this structure for Alberta. This will be the subject of the next chapter.

The second area we will look at more closely which arises out of this chapter is the area of "forward" and "backward" linkages. As we have seen much of the industrialization of Alberta has been dependent on either raw materials oriented industries linking to our natural resource base or industries developing to supply inputs to the natural resource base industries. In Chapter VI then we will look at the whole area of forward and backward linkages as they occur in Canada and elsewhere. It is hoped that from this we may also be able to make some conclusions about which industries might best be encouraged to locate in Alberta.

TABLE 8

BRITISH COLUMBIA

SELECTED PRINCIPAL STATISTICS ON TOTAL ACTIVITY OF THE LEADING MANUFACTURING INDUSTRIES RANKED BY TOTAL VALUE ADDED (a) (b)

1967

Rank	Industry	Total Employees	Total value added
1	Sawmills and planing mills	24,798	256,921
2.	Pulp and paper mills	12,960	227,236
3	Veneer and plywood mills	7,465	75,233
4	Shipbuilding and repair	3,542	37,314
5	Publishing and Printing	2,971	36,979
6	Fish products industry	3,152	30,748
7	Miscellaneous machinery & equipment manufacturers	2,699	29,561
8	Petroleum refining	923	26,780
9	Bakeries	2,963	24,035
10	Fabricated structural metal industry	1,781	24,031
11	Dairy factories	2,409	23,782
12	Breweries	705	21,338
13	Fruit and vegetable canners and preservers	1,978	20,092
14	Commercial printing	2,025	19,950
15	Metal stamping, pressing & coating industry	1,473	19,578
16	Sash, door & other millwork plants	1,944	19,406

(Table 8, continued)

17	Machine shops	1,709	16,054
18	Slaughtering & meat packing plants	1,496	15,166
19	Ready-mix concrete manufacturers	977	14,513
20	Shingle mills	1,474	12,880
21	Household furniture industry	1,439	11,389
22	Paint & varnish manufacturers	885	11,381
23	Miscellaneous wood industries	976	10,460
24	Wire and wire products manufacturers	850	10,401
25	Soft drink manufacturers	784	10,343
26	Iron and steel mills	827	9,864
27	Motor vehicle manufacturers	1,125	9,765
28	Miscellaneous furniture industries	855	8,569
29	Signs and Displays industry	635	8,549
30	Feed manufacturers	699	8,537
31	Hardware, tool & cutlery manufacturers	739	8,058
32	Miscellaneous metal fabricating industries	828	7,142

(Table 8, continued)

33	Ornamental & architectural metal industry	663	7,087

(a) Canada, Dominion Bureau of Statistics, Manufacturing Industries of Canada, Section F, British Columbia, Yukon and Northwest Territories, 1964, (Ottawa: The Queen's Printer, 1968) p. 17.

(b) We note that this table only includes industries to which the confidentiality requirements of the D.B.S. do not apply.

TABLE 9

SASKATCHEWAN

SELECTED PRINCIPAL STATISTICS ON TOTAL ACTIVITY OF THE LEADING MANUFACTURING INDUSTRIES RANKED BY TOTAL VALUE ADDED (a) (b)

1967

Rank	Industry	Total Employees	Total value added
1	Petroleum refining	725	17,077
2	Slaughtering & meat processors	1,481	16,595
3	Dairy factories	1,483	12,212
4	Publishing & printing	1,137	10,341
5	Flour mills	473	9,871
6	Breweries	354	9,478
7	Ready-mix concrete manufacturers	346	8,251
8	Bakeries	1,029	7,811
9	Soft drink manufacturers	473	5,416
10	Fabricated structural metal industry	513	5,313
11	Agricultural implement industry	378	4,879
12	Metal stamping, pressing & coating industry	518	4,374
13	Manufacturers of industrial chemicals	162	3,704
14	Commercial printing	440	3,570
15	Sawmills & planing mills	479	3,233

(Table 9, continued)

16	Miscellaneous wood industries	237	2,922
17	Sash, door & other millwork plants	385	2,906
18	Concrete products manufacturers	337	2,802
19	Feed manufacturers	125	1,767
20	Machine shops	212	1,635
21	Scientific & professional equipment manufacturers	173	1,358
22	Miscellaneous machinery & equipment manufacturers	133	1,335
23	Poultry processors	327	1,313
24	Other petroleum & coal products industries	61	769
25	Ornamental & architectural metal industry	101	739
26	Other chemical industries, n.e.s.	36	516

(a) Canada, Dominion Bureau of Statistics, Manufacturing Industries of Canada Section E, Praire Provinces, 1964 (Ottawa: The Queen's Printer, 1968) p. 43.

(b) We note that this table only includes industries to which the confidentiality requirements of the D.B.S. do not apply.

TABLE 10
MANITOBA
SELECTED PRINCIPAL STATISTICS ON TOTAL ACTIVITY OF THE LEADING MANUFACTURING INDUSTRIES RANKED BY TOTAL VALUE ADDED (a) (b)

1967

Rank	Industry	Total Employees	Total value added
1	Slaughtering and meat packing plants	2,910	25,499
2	Agricultural implement industry	1,980	19,773
3	Publishing and printing	1,981	18,482
4	Commercial printing	1,841	15,428
5	Dairy factories	1,386	12,474
6	Fabricated structural metal industry	1,079	11,581
7	Breweries	735	11,149
8	Miscellaneous food manufacturers	847	11,120
9	Bakeries	1,381	11,016
10	Metal stamping, pressing and coating industry	1,172	10,903
11	Petroleum refining	439	10,636
12	Women's clothing factories and contractors	2,067	10,712
13	Miscellaneous metal fabricating industries	903	9,737
14	Sof drink manufacturers	691	8,562
15	Fruit and vegetable canners and preservers	727	8,400
16	Household furniture industry	1,048	7,591
17	Feed manufacturers	425	6,010

(Table 10,continued)

18	Concrete products	521	5,788
19	Miscellaneous furniture industries	862	5,448
20	Sash,door and other millwork plants	640	4,990
21	Machine shops	564	4,913
22	Miscellaneous paper converters	372	4,823
23	Motor vehicle parts and accessories manufacturers	428	4,084
24	Ready-mix concrete manufacturers	244	4,036
25	Heating equipment manufacturers	490	3,768
26	Ornamental and architectural metal industry	413	3,736
27	Paint and varnish manufacturers	266	3,611

(a) Canada, Dominion Bureau of Statistics, Manufacturing Industries of Canada, Section E, Prairie Provinces, 1964 (Ottawa: The Queen's Printer, 1968) p. 19.

(b) We note that this table only includes industries to which the confidentiality requirements of the D.B.S. do not apply.

TABLE 11

ONTARIO

SELECTED PRINCIPAL STATISTICS ON TOTAL ACTIVITY OF THE LEADING MANUFACTURING INDUSTRIES RANKED BY TOTAL VALUE ADDED (a) (b)

1967

Rank	Industry	Total Employees	Total value added
1	Motor vehicle manufacturers	34,725	868,305
2	Iron and steel mills	34,593	533,725
3	Motor vehicle parts and accessories manufacturers	33,536	397,003
4	Miscellaneous machinery & equipment manufacturers	32,060	377,954
5	Pulp and paper mills	21,264	299,734
6	Manufacturers of industrial chemicals	12,274	268,341
7	Office and store machinery manufacturers	8,504	225,884
8	Manufacturers of electrical industrial equipment	19,960	217,118
9	Comminications equipment manufacturers	23,284	215,239
10	Commercial printing	21,303	209,478
11	Metal stamping, pressing and coating industry	17,257	200,853
12	Publishing and printing	16,554	188,374
13	Miscellaneous metal fabricating industry	14,526	154,007
14	Aircraft and parts manufacturers	16,816	150,690
15	Miscellaneous food industries	7,961	143,092

(Table 11,continued)

16	Dairy factories	13,048	132,165
17	Distilleries	3,108	126,754
18	Fruit and vegetable canners and preservers	11,866	126,398
19	Instrument and related products manufacturers	9,705	117,345
20	Agricultural implement industry	10,961	112,705
21	Miscellaneous paper converters	9,882	110,826
22	Manufacturers of soap and cleaning compounds	4,498	110,699
23	Smelting and refining	11,554	107,702
24	Wire and wire products manufacturers	10,401	107,241
25	Fabricated structural metal industry	8,272	106,595
26	Slaughtering and meat packing plants	10,113	105,864
27	Hardware, tool and cutlery manufacturers	9,893	105,288
28	Manufacturers of pharmaceutical and medicines	6,219	104,521
29	Breweries	2,880	104,521
30	Manufacturers of major appliances (electric & non-electric)	9,622	102,577
31	Bakeries	12,840	97,635
32	Other rubber industries	7,743	89,841

(Table 11, continued)

33	Plastics fabricators n.e.s.	9,740	87,538
34	Household furniture industry	11,878	85,411
35	Other chemical industries n.e.s.	5,378	84,474
36	Manufacturers of miscellaneous electrical products	8,287	82,950
37	Petroleum refining	2,922	82,860
38	Iron foundries	8,819	80,696

(a) Canada, Dominion Bureau of Statistics, *Manufacturing Industries of Canada, Section D, Province of Ontario*, 1964 (Ottawa: The Queen's Printer, 1968) p. 17.

(b) We note that this table only includes industries to which the confidentiality requirements of the D.B.S. do not apply.

TABLE 12

QUEBEC

SELECTED PRINCIPAL STATISTICS ON TOTAL ACTIVITY OF THE LEADING MANUFACTURING INDUSTRIES RANKED BY TOTAL VALUE ADDED (a) (b)

1967

Rank	Industry	Total Employees	Total value added
1	Pulp and paper mills	28,649	399,891
2	Smelting and refining	14,331	235,373
3	Aircraft and parts manufacturers	17,063	178,743
4	Women's clothing factories	19,963	132,028
5	Miscellaneous machinery and equipment manufacturers	12,022	120,965
6	Communications equipment manufacturers	14,407	119,699
7	Tobacco products manufacturers	6,624	102,995
8	Commercial printing	10,638	99,493
9	Manufacturers of pharmaceuticals and medicines	5,779	96,139
10	Men's clothing factories	16,999	96,026
11	Synthetic textile mills	12,263	94,740
12	Cotton yarn and cloth mills	12,397	92,812
13	Miscellaneous food industries	4,426	89,160
14	Publishing and printing	7,540	85,982
15	Metal stamping & coating industry	8,228	84,395

(Table 12,continued)

16	Bakeries	11,238	83,318
17	Dairy factories	7,494	77,321
18	Manufacturers of industrial chemicals	4,140	71,592
19	Petroleum refineries	2,418	70,554
20	Soft drink manufacturers	5,788	69,502
21	Breweries	3,371	67,714
22	Household furniture industry	9,254	67,180
23	Sawmills and planing mills	9,505	65,524
24	Shipbuilding and repair	8,610	65,205
25	Slaughtering and meat packing plants	6,155	64,874
26	Shoe factories	11,047	62,104
27	Other knitting mills	8,022	55,625
28	Manufacturers of miscellaneous electrical products	4,761	54,760
29	Wire and wire products manufacturers	4,467	50,673
30	Manufacturers of electric wire and cable	3,291	49,085
31	Distelleries	1,839	48,505
32	Plastics fabricators, n.c.a.	4,431	42,250
33	Iron and steel mills	4,073	40,890
34	Miscellaneous paper converters	3,682	40,154

(Table 12, continued)

35	Miscellaneous furniture industries	5,302	39,881
36	Fabricated structural metal industry	4,452	37,991
37	Feed manufacturers	2,994	37,544

(a) Canada, Dominion Bureau of Statistics, Manufacturing Industries of Canada, Section C, Province of Quebec, 1964 (Ottawa: The Queen's Printer, 1968) p. 17.

(b) We note that this table only includes industries to which the confidentiality requirements of the D.B.S. do not apply.

TABLE 13

BRITISH COLUMBIA

INDUSTRIES SHOWING THE FIFTEEN LARGEST COMPARATIVE GAINS AND LOSSES

Industries Showing Comparative Gains

Industry	Comparative gain $'000
Pulp and paper	96,917
Sawmills	19,345
Miscellaneous machinery	17,171
Petroleum and refining	9,330
Motor vehicles	6,391
Metal stamping	6,016
Machine shops	5,555
Wire and wire products	5,384
Distilleries	4,825
Hardware and tools	3,772
Fabricated metal	3,533
Miscellaneous metal fabricating	3,154
Men's clothing	3,041
Railroad rolling	2,767
Point and varnish	1,960

Industries Showing Comparative Losses

Industry	Comparative Loss $'000
Plastics and synthetics	8,791
Fish products ind.	7,918
Fruit and vegetable canning	5,497
Concrete products	4,156
Signs and displays	3,739
Miscellaneous food	3,549
Shipbuilding	3,151
Motor parts and accessories	3,130
Printing and publishing	2,357
Bags and boxes	2,181
Butter and cheese	1,706
Aircraft and parts	1,495
Sash and door	1,479
Slaughtering	1,194
Wooden box	809

TABLE 14

ONTARIO

INDUSTRIES SHOWING THE FIFTEEN LARGEST COMPARATIVE GAINS AND LOSSES

Industries Showing Comparative Gains

Industry	Comparative gain $'000
Commercial electrical equipment	65,477
Glass and glass products	32,857
Major electrical appliances	30,917
Petroleum products	23,914
Tobacco products	23,219
Household radio and television	20,917
Railroad rolling stock	15,545
Distilleries	15,107
Household furniture	15,002
Small electrical appliances	14,126
Synthetic textiles	13,765
Iron and steel	12,229
Breweries	12,175
Miscellaneous machinery	11,875
Metal stamping	9,929

Industries Showing Comparative Losses

Industry	Comparative Loss $'000
Smelting and refining	77,348
Steel pipe and tube	34,258
Aircraft and parts	32,746
Agriculture implements	23,099
Ornamental iron	21,882
Heating equipment	21,628
Pulp and paper	18,809
Sawmills	17,597
Rubber goods	15,999
Miscellaneous machine	11,875
Slaughtering	11,808
Miscellaneous fabricating	12,121
Flour mills	11,130
Wool cloth	11,117
Iron foundaries	10,945

TABLE 15

QUEBEC

INDUSTRIES SHOWING THE FIFTEEN LARGEST COMPARATIVE GAINS AND LOSSES

Industries Showing Comparative Gains

Industry	Comparative gain $'000
Smelting and refining	89,016
Miscellaneous machinery	49,358
Metal stamping	29,405
Commercial printing	26,976
Aircraft and parts	28,343
Miscellaneous electrical equipment	25,562
Wire and wire products	22,422
Cotton yarn and cloth	21,672
Concrete products	15,919
Glass and glass products	15,286
Ornamental iron works	14,568
Miscellaneous metal	14,464
Household furniture	12,260
Machine shop	11,111
Mfg. of electrical industrial equipment	9,759

Industries Showing Comparative Losses

Commercial electrical equipment	56,500
Pulp and paper	55,192
Petroleum refining	38,660
Tobacco products	22,275
Synthetic textiles	18,815
Distilleries	18,506
Plastics and synthetics	14,712
Railroad rolling	13,680
Butter and cheese	12,942
Men's clothing	11,025
Cement	9,676
Major electrical appliances	8,736
Shoe factories	7,969
Veneer and plywood	7,939

TABLE 16

MANITOBA

INDUSTRIES SHOWING THE FIFTEEN LARGEST COMPARATIVE GAINS AND LOSSES

Industries Showing Comparative Gains

Wire and wire products	5,868
Fruit and vegetable canning	3,832
Railroad rolling	3,431
Men's clothing	2,569
Sash and door	1,074
Concrete products	1,053
Soap and cleaning	789
Motor parts and accessories	737
Glass products	690
Household furniture	609
Stone products	429
Paint and varnish	352
Motor vehicles	327
Boat building	190

Industries Showing Comparative Losses

Industry	Comparative Loss $'000
Feed manufacturing	15,402
Ornamental iron	13,473
Miscellaneous metal fabricating	9,449
Slaughtering	9,112
Metal stamping	8,859
Aircraft and parts	6,457
Cement	5,524
Broom and brushes	4,754
Petroleum	4,315
Lime	3,996
Agricultural implements	3,216
Boxes and bags	2,609
Sawmills	2,523
Wool cloth mills	2,328
Miscellaneous food	2,470

CHAPTER V

TRANSPORTATION COSTS

Both in Chapter II and in the last chapter the importance of the cost of transportation as a locational factor was stressed. It is the purpose of this chapter to look more closely at the costs of transportation between Alberta and the larger market areas and ports of Central Canada, with a view towards making some initial comments on the extent to which the industrialization of Alberta has been affected by these costs.

First the ideas of Chapters II and IV with respect to transportation costs should be briefly consolidated. This can be done by looking at the tendencies for industrial location which result from reducing transportation costs to a very low level and then from raising these costs to a high level.

A lowering of transportation costs between Alberta and the major market-industrial area of Canada would first of all make Alberta's resource based industries more competitive in this market. This has been the traditional goal of much work in the west including Alberta. Examples of the results of this work are the building of pipelines to the east and the Crowsnest Pass Agreement of 1897.[1] Both of these developments served to lower the cost of getting resource based products to market thus bettering the

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[1] Report of the Royal Commission on Transportation Vol. II December 1961 (Ottawa: The Queen's Printer, 1961) p. 96.

competitive position of these products. Depending on other world conditions such as the prices of these same products from competing sources we might expect an increase in the sales and production of these products. It does not, for reasons discussed below, follow so clearly that the production of the peripheral or processing industries will also increase.

Much of the processing of the basic resource materials can be attributed to the fact that through processing these resources lose weight and thus are cheaper to ship to final market. If transportation costs become lower this locational factor is less important and thus another locational factor, such as external economies resulting from location in a major market area, may become dominant. A lowering of transportation costs then could mean a loss of processing industries for Alberta.

The same sort of logic applies to those industries which supply inputs to the basic resource industries. These industries in locating in Alberta must compete with already established competitors from other regions. If transportation costs into the province are lowered it becomes less likely that there will be an incentive for backward linkages to form within the province.

On the other hand a lowering of transportation costs may enable certain industries to compete for the main markets of Canada from an Alberta location. Again this depends on the other locational factors involved.

It can be said that in so far as our purpose is increased industrialization the lowering of transportation costs is not an unmixed blessing. The effects of a lowering of transportation costs can only be determined by empirical study into several areas. Knowledge of the demand elasticity faced by Alberta's main resource products is necessary. As well we would need to know the locational factors affecting the various peripheral industries around the resource core. Without a much more complete study of these factors little can be said of the effects of the lowering of transportation costs.

If transportation costs were to rise we can expect just the opposite effects. The basic export resource oriented industries would become less competitive for markets outside the region. Peripheral industries would have a greater measure of protection however and may do better. Again then the effects of a change in transportation costs can only be determined by a much more complete study than we are able to do here.

The Structure of Canadian Freight Rates

The structure of existing Canadian railway freight rates will be looked at here as a basis for future work. It is an area of very great complexity; therefore only a few comments will be made. We will deal only with rail rates here for two reasons. First for our purposes here rail and truck rates are the most important. Second,

to the extent that these two transportation methods compete, a study of rail rates should throw light on the cost of both types of transportation.

The price structure for the use of rail freight facilities in Canada is so complex that the best that can be done in the time and space available for this study is to outline the existing price structure. From this structure it will be possible to point out areas where further work is needed. A general outline of the Canadian rail price structure is contained in the book Economics of Canadian Transportation by A.W. Currie.[2]

The core of the freight rate structure might be said to be the Canadian Freight Classification. This classification contains a list of items[3] in alphabetical order. For each item there is a description, a rating applicable if the item is shipped in less than carload lots, a rating if the item is shipped in carload lots, and sometimes a code circumscribing the responsibility of the railroad for specific types of damage. In 1954 there were ten classes of freight, called first to tenth and in addition nine multiples of the first class; 1 1/4, 1 1/2, 1 3/4, D-1 (double first) 2 1/2 t 1 (two and one-half times first), 3 t 1, 3 1/2 t 1, 4 t 1,

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[2] A.W. Currie, Economics of Canadian Transportation (Toronto: University of Toronto Press, 1954) p. 178-231.

[3] In 1954, when Currie's book was published there was approximately 15,000 items in the classification list ibid, p. 184.

4 1/2 t 1.[4]

The items making up each class have very little in common. Currie does however include a quotation giving broad characteristics of each rating.

> First class includes commodities of bulky character or high value [e.g. clothing], of which a comparatively small tonnage moves and then only in less-than-carload quantities. Second class comprises those commodities which are slightly less bulky or valuable [most groceries, L.C.L.], but which move in relatively greater tonnage, although still confined to less-than-carload quantities. Third class comprises the ordinary merchandise commodities [toilet soap, L.C.L.; butter, C.L.] in compact packages of comparatively great weight and small cubic measurements, moving in less than carloads. Fourth class covers articles of light weight and bulky in dimension [e.g. refrigerators, C.L.] or fragile in character, of comparatively high value, moving in low minimum carloads. Fifth class includes general merchandise [e.g. canned fruits and vegetables] moving in carload lots, generally speaking of the same character that would take third-class rate in less than carloads. This class covers a substantial tonnage ... Sixth class, as a rule, covers flat car merchandise traffic, like machinery, agricultural implements, boars, canoes, launches, etc. Seventh class includes railway equipment and supplies [also chemical fertilizers]. Eight class covers stock. Tenth class covers products of the forest, the mine, and the quarry. ... Of these classes the first six may be considered as merchandise, while the other four are regarded as commodity classes. 5

Once the class rating of the commodity to be shipped is known the next step is to find the minimum official

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[4] *Ibid.*, p. 185.

[5] W. T. Jackman, *Economic Principles of Transportation* (Toronto: The University of Toronto Press, 1935) p. 158.

distance from origin to destination. With both the class rating and the official distance known the rate in cents per one-hundred pounds can be found.

While these class rates might be said to be the core of the Canadian freight rate structure they are not the rates which apply to the majority of shipments. It can be seen from Table 17 that only 1.6% of freight ton-miles were charged at this type of rate. Despite the fact that only a small proportion of total shipping is done under these rates they would seem to be the logical basis of the freight rate structure.

Further reference to Table 17 shows that the majority of shipping was done under several other rate categories which we will now discuss. Special rates exist for certain commodities. These are referred to in Table 17 as "Commodity non-competitive". Commodity non-competitive rates exist to allow certain low valued goods to be moved in volume.[6] Iron and steel, newsprint and cement are examples of commodities enjoying these special rates. Sometimes these special tariffs apply over all stations of the carrier concerned and sometimes only from one specified point to another.[7]

Another type of commodity tariff is in response to competition from truck or water transport. These tariffs apply to specific items between specific points. On Table

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[6] Currie, p. 29.

[7] *Ibid.*, p. 180.

TABLE 17

STATISTICS RELATING TO CATEGORIES OF FREIGHT RATES FOR 1964 (a)

Category of Freight Rate	% of sample revenue	% of sample ton-miles	avg.revenue per freight ton-mile	avg.revenue per freight car mile
class rated	4.7	1.6	4.03	0.63
Commodity non-competitive	29.6	27.6	1.50	0.66
Commodity Competitive	27.3	15.3	2.50	0.68
Agreed Changes	25.2	18.8	1.87	0.67
Statutory grain rates	13.2	36.7	0.50	0.28
Total	100.0	100.0	1.40	0.57

(a) from: Board of Transport Commissioners for Canada, Waybill Analysis Carload All-Rail Traffic: 1964 (Ottawa, The Queen's Printer, 1965) p. 35.

17 these tariffs are referred to as "Commodity Competitive". It is these special tariffs which have resulted in some anomalies often criticised from within Alberta. In order to meet steamship rates from the ports of Eastern and Central Canada to the Pacific Coast transcontinental rates have often been set at lower than the rates to intermediate points. Several specific cases of this problem were outlined to the Royal Commission on Transportation of 1951 by the Alberta Government. An example cited was the fact that vegetable canners of Southern Alberta were unable to compete with canners from Central Canada for the markets of south-western British Columbia because of competitive rates.[8] At the time of the 1951 Royal Commission report there were cases where an Edmonton or Calgary distributor would find his freight costs from the east lessened if his goods were first shipped to the Pacific Coast and then back to Edmonton or Calgary, even if this was done all by rail.[9]

Considerable freight is also carried on the basis of "agreed charges". These are special low rates which the railroads make available to shippers in exchange for an agreement from the shippers to send a certain portion (usually about 90 percent) of his traffic by the railroad.[10]

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[8] Report of the Royal Commission on Transportation (Ottawa: the King's Printer, 1951) p. 31.

[9] Ibid., p. 100.

[10] John M. Munro, Trade Liberalization and Transportation in International Trade (Toronto: University of Toronto Press, 1969) p. 76.

Finally a portion of the rail freight traffic is made up of grain shipped under various "statutory grain rates". Special rates exist for shipment of grain and flour to Fort William and Port Arthur, Churchill, and Vancouver along with other Pacific Coast ports.[11]

The first comment we might make relates to the difficulties involved in drawing conclusions about the effects of freight rates on the industrialization of Alberta. A number of areas will need to be looked at in much more depth before any conclusion can be drawn. It will be necessary to try to form some synthesis of the various types of freight rates such that general comments can be made on the costs of shipping manufactured goods to and from Central Canada. A study of the costs to the railroads, involved in shipping the various types of goods is also necessary such that it can be seen which types of goods and which regions of Canada bear a more than proportionate share of the costs. Finally one might look at the areas of obvious Government intervention, such as the statutory grain rates, with a view towards finding the effect of these policies on industrialization in Alberta.

While it would require a work at least the length of this thesis to undertake the above studies we might make a few suggestions here with respect to directions which might be taken. The problem of finding the actual charges

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[11] Board of Transport Commissioners for Canada, Waybill Analysis Carload All-Rail Traffic: 1964 (Ottawa, The Queen's Printer, 1965) p. 1.

for moving various types of freight within Canada might be approached using the analysis of waybills published by the Board of Transport Commissioners. This method was used by Munro in a study entitled Trade Liberalization and Transportation in International Trade.[12] With proper classification and some statistical work it should be possible to reach some conclusion with respect to the relative levels of rates between commodities, between directions, and between regions. As Munro points out, this procedure has the advantage that the study would not be influenced by rates which are published but under which little or no traffic moves.

Much has been written on the costs of various types of rail service and the charges which result. The railroads in Canada are in the position of having very close to a monopoly position for shipments between certain areas or of certain commodities. For other routes or for other commodities competition from other railways, highway or water transport, or pipelines is very stiff. Rates must be set for all routes and all commodities so as to take these realities into account. The setting of rates is further complicated, as mentioned above, by the intervention of government in an effort to meet certain national objectives. The statutory grain rates which aid the prairie farmer in meeting world competition are an example of this.

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[12] Munro, p. 102.

To comment on freight rates and the effect of these rates on the industrialization of Alberta all of these areas must be dealt with. The reports issued by the Royal Commission on Transportation of 1959 has much comment on the problems involved in the pricing of railway services.[13]

The areas of government intervention, such as various subsidies and statutory rates might also be looked at. A number of direct subsidies exist which are paid either directly to the railroads or to shippers. The Maritime Freight Rates Act of 1927 is an example of this type of intervention. This act provides for Federal Government subsidization of shipments originating in "select territory". "Select territory" as referred to here is made up of the Atlantic Provinces and that part of the Province of Quebec east of Quebec city. The subsidies are such as to allow a 20 percent reduction of railway freight rates on shipments within the select territory and a 30 percent reduction on shipments going outside of the territory.[14]

Another Federal Government subsidy is the "Bridge" subsidy. A number of submissions were made to the 1949-51 Royal Commission on transportation from groups in the

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[13] Report of the Royal Commission on Transportation Vol. I, March 1961 (Ottawa: The Queen's Printer, 1961).
Report of the Royal Commission on Transportation Vol. II, December 1961 (Ottawa: The Queen's Printer 1961).
Report of the Royal Commission on Transportation Vol. III, July 1962 (Ottawa, The Queen's Printer, 1962).

[14] Report of the Royal Commission on Transportation Vol. II, December 1961 (Ottawa: The Queen's Printer 1961) p. 104-105.

Western Provinces explaining the difficulties of competing in the markets of Central Canada from such a distance. The Northern Ontario region is sparsely settled and as a result yields very little revenue to the railroads. Costs of going through this area are high however, and these costs must be made up from traffic through this region between Western and Central Canada. On the advice of the 1949-51 Royal Commission the Federal Government gave a subsidy to the railways conditional upon the requirement that there be a reduction on freight rates in both directions through the "bridge" area.[15]

Two other subsidies we might mention apply to the movement of specific commodities. The transportation of coal is subsidized in order to make Canadian coal competitive with other fuels and imported coal. Most of these payments are made to aid the shipment of coal from Nova Scotia to Central Canada.[16]

Another transportation subsidy relating to a specific commodity is the Feed Grain subsidy. This subsidy is to aid in the movement of feed grains from the prairie provinces to British Columbia and the eastern provinces. The subsidy is paid directly to feed dealers who must certify that the full benefit of the subsidy has been passed on to

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[15] Ibid., p. 113-114.

[16] Munro, p. 79.

livestock or poultry dealers who buy the grain.[17]

Another type of subsidy is the deficit of the Canadian National Railways which is met by the Federal Government.[18]

Some Empirical Work

Before concluding this chapter it is worthwhile to cite some empirical work on the importance of transportation costs to manufacturing industry in Canada. Using figures derived from the 1961 Canadian input-output table,[19] transportation inputs as a percentage of the total value of production were calculated for 85 manufacturing classifications.[20] The average for this figure was 2.86%. It would therefore take a large percentage change in the cost of transportation to make very much of a change in the overall costs of production for the average manufacturing industry.

It is interesting to note that the average for the same figure, transportation inputs as a percentage of the total value of production, for the twenty-five industries which have the highest value added figures for Alberta is 3.9%. This result is shown on Table 18.

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[17] Report of the Royal Commission on Transportation, Vol. II, December 1961. (Ottawa: The Queen's Printer, 1961), p. 119.

[18] Munro, p. 78.

[19] Dominion Bureau of Statistics, The Input-Output Structure of the Canadian Economy 1961. (Ottawa: The Queen's Printer, 1969).

[20] I am indebted to R.N. Mansell for allowing me to use, with some modifications, the calculations he had done towards a closely related goal.

TABLE 18

TRANSPORTATION AS A PERCENTAGE OF TOTAL VALUE OF PRODUCTION FOR THE TWENTY FIVE INDUSTRIES CONTRIBUTING MOST TO VALUE ADDED IN ALBERTA

Industry	Transportation as a percentage of total value of production
1 Slaughtering & meat packing plants	2.4
2 Manufacturer of industrial chemicals	3.4
3 Petroleum Refineries	8.9
4 Dairy factories	1.4
5 Publishing & printing	1.7
6 Sash, door & other millwork plants	6.2
7 Fabricated structural metal industry	1.0
8 Bakeries	2.9
9 Breweries	1.8
10 Machine shops	1.8
11 Sawmills & planning mills	4.2
12 Miscellaneous machinery & equipment manufacturers	1.9
13 Metal stamping, pressing & coating industry	2.1
14 Concrete products manufacturers	9.0
15 Ready-mix concrete manufacturers	9.0
16 Commercial printing	1.7
17 Feed manufacturers	10.7
18 Soft drink manufacturers	1.4
19 Truck body & trailer manufacturers	2.8
20 Steel pipe & tube mills	3.2

(Table 18, continued)

21 Flour mills	10.4
22 Ornamental & architectural metal industry	1.4
23 Veneer & plywood mills	2.9
24 Agricultural implement industry	1.9
25 Miscellaneous wood industry	3.9
average	3.9

Four of the industries having an upward effect on the average arrived at in Table 18 are primary manufacturing industries; industries having a high natural resource content. These industries are sawmills, feed manufacturers, flour mills and petroleum refineries. Wherever final processing of the products of these industries is done,transportation is important as the sources of raw materials and the main markets for the products are generally geographically far apart. We should note here that the figures for transportation as a percentage of total value of production are for each industry in Canada as a whole not just for part of the industry contained in Alberta.

Two other industries having an upward effect on the percentage are concrete products (including ready-mix concrete) and sash and door manufacturers. These industries would appear to be large in Alberta in response to the demand for their output. While these two industries may have located so as to minimize transportation costs, these costs are still quite important for them.

In Table 19 the costs of transportation as a percentage of total value of production are given for the fifteen industries showing the largest comparative gains in Alberta and for twelve of the fifteen industries showing the largest relative losses.[21] It is interesting to note

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[21] We were unable to correspond the remaining three industries to the aggregated groups of the Input-Output table.

TABLE 19

TRANSPORTATION AS A PERCENTAGE OF TOTAL VALUE OF PRODUCTION FOR THE INDUSTRIES SHOWING LARGEST RELATIVE GAINS OR LOSSES IN ALBERTA

Industries Showing Comparative Gains

Industry	Transportation as a percentage of total value of production
Slaughtering	2.4
Pulp and paper	3.4
Ornamental iron	1.4
Glass products	3.6
Fabricated structural steel	1.0
Men's clothing	1.1
Butter and cheese	1.4
Rubber industries	1.5
Process cheese	2.9
Machine shops	1.8
Printing and publishing	1.7
Metal stamping	2.1
Asphalt roofing	4.5
Confectionery	2.7
Women's clothing	1.1
average	2.2

Industries Showing Comparative Losses

Industry	Transportation as a percentage of total value of production
Petroleum Refineries	8.9
Augo parts and accessories	2.0
Sawmills	4.2
Breweries	1.8
Concrete products	9.0
Sash and door	6.2
Fruit and vegetable canning	2.8
Miscellaneous food	5.2
Aircraft and parts	1.5
Biscuits	2.7
Miscellaneous metal	1.8
Vegetable oils	3.1
average	4.1

that the industries making relative gains in Alberta show a percentage transportation input below the average for all industries while the industries making relative losses in Alberta show a percentage transportation input well above the average for all industries.

It is difficult to arrive at a cause-effect relationship for these facts. It may be that industries are moving from Alberta in response to high transportation costs. It may be as well that some industries are moving out of Alberta for reasons apart from transportation, to gain some economies of agglomeration for example, and thus transportation costs have gone up. This may well be the case with the sash and door industry.

Two points can be made with respect to the results of this section. First, even if transportation costs in a specific industry are high, we cannot assume the industry is less likely to locate in Alberta. The optimal location for each industry will be determined according to the theory of location presented in Chapter III. In the cases where transportation costs are a relatively large percentage of the total value of production, that portion of location theory dealing with transportation costs becomes more important. Second, as other locational factors become more important the costs of transportation to the industry will rise. If, for example, the sash and door industry is centralizing production in order to take advantage of

economies of scale then transportation-costs will go up. For these two reasons it is very hard to make inferences about the relationships between the importance of transportation costs to an industry and the importance of this industry to Alberta.

Conclusions

It is obvious that, along with other locational factors, the costs of transportation between Alberta and the major industrial-market area of Canada has an effect on the amount and type of industry which locates in Alberta. We can see however that just what effect will result from a specific change in a cost of transportation requires further study. The empirical work of this chapter, while demonstrating that there is considerable range over the figures on the importance of transportation costs, does little to clarify what result might be expected from a change in all or some transportation costs. Before further comment could be made a study of the impact of freight rate changes on specific industries would be necessary.

The existing freight rate structure, as we have seen, is very complex due to the number of forces at work on these rates. We have here outlined some of the areas which make the study of the costs of transportation most complex in Canada. It can be seen that very much more work is necessary. It is obvious however that national policy with respect to freight rates has been to intervene in

the setting of these rates. As a result this would seem to be a fertile field for much greater study.

CHAPTER VI

LINKAGE EFFECTS

In Chapter IV it became evident that much of the industry in Alberta is closely related to a few basic industries; agriculture and the extraction of petroleum products being the core of these. It is felt worthwhile, therefore, to devote a section of this paper to a closer examination of linkage effects between industries and how these relate to our work here.

Linkage Effects Defined

We have, in Chapter IV, referred to linkage effects but we have not yet properly defined these effects. The introduction of certain industries into an economy has a tendency to induce further investment. Such industries can be said to have strong "linkage effects".[1] Two types of linkage effects can be defined; "forward" and "backward" linkages. The existence of an industry which is a large buyer from the rest of the economic system provides backward linkages. The agriculture industry for example is backward linked to the agricultural implement industry. An industry which is an important seller of intermediate goods, as opposed to final consumer goods, to the rest of the economic system can be said to provide forward linkages to other industries. To use the same example as above, the existence

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[1] For this section I rely heavily upon A.O. Hirshman, The Strategy of Economic Development (New Haven and London: Yale University Press, 1958), p. 98-119.

of an agriculture industry in Alberta provides a strong forward linkage to the slaughtering and meat processing industry.

Why do these linkage effects exist? In the case of backward linkages it is a result of the development of new markets. Industry A then provides a backward linkage to, or an impetus for the development of, industry B because industry A provides a market for the output of industry B. Forward linkages can be explained in much the same way. The existence of industry A which produces an intermediate good used as input by industry B provides an impetus for industry B to move closer to the location of A.

It can be seen that we can in fact define forward and backward linkages using the traditional location theory of Chapter 2. Backward linkages are due to industry B being market oriented with regard to transportation costs and perhaps also the result of the development of external economies. Forward linkages may also be partly a result of external economies developing. As well, forward linkages depend on industry B being materials oriented when transportation costs are taken into account. Thus it is possible to reduce forward and backward linkage effects within a given area to the effects of various locational factors we have already discussed. Despite this the concept of linkage effects is of a good deal of value here for two reasons. First this concept helps to subsume the various

locational factors concerned within one concept. Second, the linkage concept allows us yet another way of studying the interrelationships within our economy.

Hirschman develops two aspects of linkage effects which we might discuss here.[2] The linkage effect from industry A to industry B can be broken down into the potential importance of the linkage if it is formed and the potential for the formation of the linkage in the area of concern. Hirchman calls these two elements of the overall effect importance and strength. The importance might be measured, for example, by the "net output of the new industries that might be called forth".[3] The strength can be considered as the probability that the industries which are linked to the initial industry will actually develop.

The second element, the strength of the linkage effect, is of particular interest to our problem here. Alberta exports a large proportion of the output of its largest industries. For this reason many of the forward linkages occur outside of Alberta and even outside of Canada. Again then we can see that the linkage effects are really a concept which incorporate implicitly the area of location theory relating to transportation cost.

We might note that Hirchman places more importance

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[2] _Ibid._, p. 100-101.

[3] _Ibid._, p. 100.

on backward linkages than on forward linkages[4] in giving rise to investment. He points out that in order for the forward linkage effect to manifest itself there must also be some demand for the product concerned. This demand can either be in the form of final demand or as backward linkage from another industry. Nonetheless forward linkage can act "as an important and powerful reinforcement to backward linkage"[5] in the inducement of further investment. For this reason then the development of industries which have both large backward and large forward linkages is most important for a developing economy such as Alberta's.

Work has been done using the Canadian input-output table in an attempt to find which industries are most heavily linked to the rest of the economy. It is to this work we will turn to next.

Linkage Effects in Canada

Dimitri Sakellariou in a study comparing the linkages within the Canadian economy to the linkages which exist in the Japanese, Italian, U.S. and Norwegian economy has completed much of the work we will refer to here.[6] The Canadian output table for the year 1961 was used after

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[4] *Ibid.*, p. 116-117.

[5] *Ibid.*, p. 117.

[6] Dimitri Sakellariou, (Unpublished draft dissertation, Dept. of Economics, University of Alberta), p. 83.

aggregating it to a more manageable 38 X 38 size. Table 20 shows the aggregation done.

Two indices were used as indications of the forward and backward linkages from each of the 38 categories. The first of these indices, called by Sakellariou "indirect use", describes the link between a using sector and its supplying sectors. The indirect use for sector J is expressed as a ratio of all the purchases of sector J from other sectors to the total value of production of sector J. This index can be considered as a measure of the backward linkage effect from sector J to the rest of the economy.

The other index can be called "indirect demand". This index describes the link between supplying sector i and the sectors buying from sector i. We can express this measure as the ratio of all purchases from sector i by other sectors to the total demand for the output of sector i. In other words the indirect demand is the proportion of the output of sector i used by other sectors as inputs to the production process. The indirect demand, then, can be used as a measure of the forward linkage effects emanating from sector i.

Sakellariou has calculated these two indices for each of the 38 sectors listed in Table 20. The results of these calculations are listed in Table 21.

Using the indices given in table 21 a simple two-way classification can be done such that it is clear

TABLE 20

INDUSTRY CLASSIFICATIONS

Aggregated Sectors	Corresponding 1961 Input-output table sectors	S.I.C. Manual Classes
1 Agriculture	1	001,003,006,011,013,015 017,019,021,031,039
2 Forestry	2	031,039
3 Fishing,hunting and Trapping	3	041,045,047
4 Metal Mining and Non Ferrous Metal smelting and Refining	4,32	051-059,295
5 Coal Mining, Crude Petroleum and Natural Gas	6,7	061-066,092-099
6 Non Metal Mining, Quarrying and Prospecting	5	071,073,077,079-083 087
7 Meat Products	8	101-103
8 Dairy Products	9	105-107
9 Fish Processing	14	111,135,139
10 Fruit and Vegetables Preparations	10	112
11 Grain Mill Products	11	123,124,125
12 Bakery Products	12	128,129
13 Carbonated Beverages	15	141
14 Alcoholic Beverages	16	143,145,147
15 Confectionary and Sugar Refining	13	131,133
16 Tobacco and Tobacco Products	17	151-153
17 Rubber Products	18	161,163,169
18 Leather Products	19	172,174,175,179
19 Textile Products (Excluding Clothing)	20,21,24	183,193,197,201 211-229

(Table 20 continued)

20 Clothing (Textile and Fur)	22,23	231,239,242-249
21 Furniture	26	261,264,266,268
22 Wood Products Excluding Furniture	25,27	251,252,254,256, 258,259
23 Paper Products	28,29	271-274
24 Printing and Publishing and Allied Industries	30	286-289
25 Primary Iron and Steel	31	291
26 Agricultural Implements Iron and Steel products n.e.c. Non-Ferrous Metal Products n.e.c.	33,34,35, 36,37	301-309,311,315-318,292,294,296-298
27 Transportation Equipment	38,39,40,41	321,323,324,325, 326,327,328,329
28 Jewelery and Silverware Misc. Manuf. Industries	53	381-385,393 397,399
29 Electrical Apparatus and Supplies	42,43,44, 45	331-339
30 Non-Metallic Mineral Products	46,47	341-359
31 Products of Petroleum and Coal	48	365,369
32 Chemicals and Allied Products	49,50,51,52	371-379
33 Construction	54	404-421
34 Transportation, Storage and Trade	55,56	501-527,602-699
35 Communication	57	543-548
36 Electricity Water and Gas utilities	58	572-579
37 Finance Insurance and Real Estate	59	702-757
38 Service Industries	60,61,62, 63,64	801-991

TABLE 21

RATIOS OF INTERINDUSTRY USE

Sector	Indirect use (u_j)	Indirect demand (w_i)
1	36.6	65.7
2	46.3	89.9
3	25.8	71.2
4	47.0	45.0
5	37.0	60.6
6	30.3	41.3
7	76.7	26.8
8	71.4	20.4
9	71.4	33.9
10	61.3	20.0
11	77.8	69.1
12	54.1	12.9
13	43.9	22.8
14	47.7	11.3
15	39.1	33.1
16	70.8	22.0
17	41.2	65.8
18	55.1	22.1
19	44.3	71.3
20	48.9	11.9
21	46.8	13.2
22	60.2	58.7
23	52.1	44.8
24	41.2	65.9
25	46.9	85.5
26	49.0	62.3
27	47.7	30.2
28	44.9	37.3
29	45.2	43.9
30	47.2	81.7
31	52.8	58.3
32	49.6	60.6
33	47.7	15.4
34	32.2	37.1
35	20.9	56.6
36	31.2	60.9
37	21.4	26.8
38	56.6	64.1
mean	47.9	45.3

which sectors are more heavily backward linked, forward linked or both. Those sectors which have an index of "indirect use" (u_j) above the mean of 47.9 can be said to be more heavily backward linked. Those sectors with an "indirect demand" index (w_i) of greater than the mean of 45.3 can be said to be heavily forward linked. Using these criteria the sectors can be divided as in Table 22.

Industries in quadrant I of the Table 22 are those which show both above average forward and above average backward linkages. A growth in these sectors would have the most tendency to induce further investment in the economy as a whole. Sectors of the economy listed in quadrant II are those which show above average backward linkage effect but below average forward linkage effect. These sectors, as we might expect, primarily supply final demand rather than intermediate goods. Sectors listed in quadrant IV are those with above average forward linkage effect but below average backward linkage effect. Finally the sectors listed in quadrant III show below average effects in both directions. A rough ordering of the 38 sectors with respect to the power of investment in a given sector to induce further investment within the economy would have the industries of quadrant I first then those from quadrant II, then those from quadrant IV and finally those from quadrant III.

Several comments can be made about these results with respect to our purposes here. First we might note that while certain sectors show heavy linkage effects these

TABLE 22

CLASSIFICATION OF PRODUCTIVE SECTORS

1961

	Below Mean Forward Linkage, $w_i < 45$	Above Mean Forward Linkage, $w_i > 45$
above mean indirect use Backward Linkage $u_j > 47$	II 7 Meat Products 8 Dairy Products 9 Fish Products 10 Fruit & Vegetable prep. 12 Bakery products 14 Alcoholic Beverages 16 Tobacco and Products 18 Leather Products 20 Clothing 23 Paper Products 27 Trans. Equip. 33 Construction	I 11 Grain mill products 22 Wood products 26 Agricultural implements 31 Products of Petroleum and Coal 32 Chemicals 38 Service Industries
belowmean indirect use $u_j < 47$	III 4 Metal mining 6 Non-Metal mining 13Carbonated Beverage 15Confectionary and Sugar refining 21Furniture 28Misc. Manuf.ind. 29Electrical Apparatus 37 Finance, Insurance & Real Estate	IV 1 Agriculture 2 Forestry 3 Fishing Hunting & Trapping 5 Coal Mining, Petroleum 17 Rubber Products 19 Textile Products 24 Printing and Publishing 25 Primary Iron & Steel 30 Non Metallic Mineral Prod. 34 Transportation & Storage 35 Communication 36 Electricity, Water & Gas

linkages are not necessarily to industries as we have defined them in this study. Grain mill products for example show above average linkage effects in both directions. Backward linkages from this industry are directly through the purchase of grain to the agricultural sector rather than to an industry as we have defined industry. A portion of the forward linkage effect is to the agricultural sector as well by way of the manufacture of feed. Thus investment in some of the sectors listed here as having strong linkage effects may not give rise to furtherinvestment of the type we are concerned with here.

A second comment relates to the level of agglomeration used in this study. A sector showing heavy linkages in both directions is given the heading Agricultural Implements. This category includes, as an example, the Standard Industrial Classes listed in Table 23. We can therefore see

TABLE 23

3-DIGIT CLASSES INCLUDED IN AGRICULTURAL IMPLEMENTS

S.I.C.	
292	Steel pipe and tube mills
294	Iron foundries
296	Aluminum rolling, casting and extruding
297	Copper and alloy rolling, casting and extruding
298	Metal rolling, casting and extruding n.e.s.
301	Boiler and Plate Works
302	Fabricated Structural metal industry
303	Ornamental and architectural metal industry
304	Metal stamping, pressing and coating
305	Wire and wire products manufacturers
306	Hardware, tool and cutlery manufacturers
307	Heating equipment manufacturers
308	Machine shops
309	Miscellaneous metal fabricating industries
311	Agricultural implement industry
315	Misc. Machinery and equipment manufacturers
316	Commercial refrigeration and air conditioning equipment manufacturers
318	Office and store machinery manufacturers

that statements using the information put forth here can only be very general.

The third area of comment relates to the location of the induced investment. The calculations done here use all of Canada as "the economy". Exports out of the country are included as final demand. Thus it may be that there is a strong linkage effect which does not show up because it is to an industry outside of Canada. With respect to our study on attracting industry to Alberta, it is possible that the linkage effects emanating from a sector of the economy will be, for example, to more market oriented industries which will thus be more likely to locate in the more populous region of Canada. We have no guarantee, therefore, that the locational factors affecting those industries which are linked to an industry initially invested in will give rise to further investment in Alberta. In each case it is necessary to look at the locational factors affecting the peripheral or linked industries before recommending investment in a specific industry in our province.

Linkage Effects; Important, and Gaining Industries in Alberta

Several conclusions can be drawn out of the discussion on linkage effects put forward here and in Chapter IV. As we saw in Chapter IV the industrialization

of Alberta is to a very large extent due to the linkages emanating from the production of agricultural and petroleum products. This is reinforced by the results of the empirical work of this chapter. We can categorize the twenty-five industries listed in Table 2, in Chapter IV, according to the linkage effects emanating from each. This categorization is done in Table 23.

We can see from Table 23 that the most important industries in Alberta show heavy linkage effects to the rest of the economy. These results provide more evidence of the fact that the development of Alberta's manufacturing industries is dependent upon the natural resource base.

Further comment can be made if we categorize the industries showing relative gains and losses (from Table 4) in Alberta by the type of linkage effects they possess. This is done in Tables 24 and 25.

First of all we might point out a limitation of the information in these two Tables. As was mentioned before the information on linkage effects was for very aggregated categories. When we say that an industry such as machine shops shows both above average backward and forward linkage effects we mean that the aggregate category in Table 20 which contains machine shops shows these types of linkage effects. It may be in fact that the linkage effects emanage largely from other industries within the aggregate category.

TABLE 24

THE TWENTY-FIVE MANUFACTURING INDUSTRIES WITH THE HIGHEST VALUE ADDED FIGURES FOR ALBERTA CATEGORIZED BY TYPE OF LINKAGE EFFECT

I Industries with Above Average Forward and Backward Linkage Effects.

- Manufacture of Industrial Chemicals
- Petroleum Refineries
- Sash Door and Millwork Plants
- Fabricated Structural Metal Industry
- Machine Shops
- Sawmills and planning Mills
- Miscellaneous Machinery and Equipment manufacturers
- Metal Stamping, Coating and Pressing Industry
- Feed Manufacturers
- Steel Pipe and Tube Mills
- Flour Mills
- Ornamental and Architectural Metal Industry
- Veneer and Plywood Mills
- Agricultural implement Industry
- Miscellaneous Wood Industries

II Industries with Above Average Backward Linkage Effects but Below Average Forward Linkage Effects

- Slaughtering and Meat Processing
- Dairy Factories
- Bakeries
- Breweries
- Truck Body and Trailer manufacturers

III Industries with Above Average Forward Linkage Effects but Below Average Backward Linkage Effects

- Printing and Publishing
- Concrete Products
- Ready-mix concrete
- Commercial printing

IV Industries with Below Average Forward and Backward Linkage Effects

- Soft Drink manufacturers

TABLE 25

INDUSTRIES SHOWING RELATIVE GAINS IN ALBERTA CATEGORIZED BY TYPE OF LINKAGE EFFECT

I Industries with Above Average Forward and Backward Linkage Effects

Ornamental and Architectural metal industry
Fabricated Structural metal industry
Machine Shops
Metal Stamping, Coating and Pressing Industry

II Industries with Above Average Backward Linkage Effects but Below Average Forward Linkage Effects

Slaughtering and Meat Processing
Pulp and Paper
Men's Clothing
Butter and Cheese
Process Cheese
Asphalt Roofing
Women's Clothing

III Industries with Above Average Forward Linkage Effects but Below Average Backward Linkage Effects

Glass Products
Rubber Industries
Printing and Publishing

IV Industries with Below Average Forward and Backward Linkage Effects

Confectionary Products

TABLE 26

INDUSTRIES SHOWING RELATIVE LOSSES IN ALBERTA CATEGORIZED BY TYPE OF LINKAGE EFFECT

I Industries with Above Average Forward and Backward Linkage Effects

- Petroleum Refining
- Saw Mills
- Sash and Door
- Miscellaneous Metal
- Wooden Box

II Industries with Above Average Backward Linkage Effects but Below Average Forward Linkage Effects

- Auto Parts and Accessories
- Breweries
- Fruit and Vegetable Canning
- Miscellaneous Food
- Aircraft and Parts
- Biscuits
- Animal oils and fats
- Vegetable Oils

III Industries with Above Average Forward Linkage Effects but Below Average Backward Linkage Effects

- Concrete Products

IV Industries with Below Average Forward and Backward Linkage Effects

- Signs and Displays

This warning aside however, we can note the fact that the preponderence of industries from both those showing relative gains and those showing relative losses have strong linkage effects to the rest of the economy. This would introduce the possibility that heavily linked industries, as defined by Sakellariou, are the more important in the Canadian and Alberta economy, in that these industries contribute more than proportionately to the Gross National Product. Further work should be done to calculate the portion of the Gross National product attributable to the industries in each of the four quadrants of Table 22. Whatever the case it does not appear from our work here that Alberta is showing a relative gain or loss in industries with a heavy linkage effect.

Conclusions

The concept put forth in this chapter would therefore seem to be a quite fruitful one. What is needed however is a study of the same type but using a much larger, i.e. less aggregated, input-output table. A Canadian input-output table exists for the year 1961 which is 110 industries by 197 commodities.[7] A study which used a

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[7] Dominion Bureau of Statistics, The Input-Output Structure of the Canadian Economy 1961 (Ottawa: The Queen's Printer, 1969), p. 3.

table of this size could be much more specific about the links between various industries.

With a much more complete concept of the linkage effects within the Canadian economy it should then be much more possible to derive those industries which might best be fitted into the Alberta industrial structure. It is interesting to use Hirschman's analogy comparing the development of linkage effects within the economy to a jigsaw puzzle; "if a piece is surrounded from several sides, it is easier to fit it in."[8] Given the knowledge of which industries are most closely linked to the existing Alberta structure one can see which are not located here and why.

A concept which is worth developing somewhat further at this point is the idea of a "primary-manufacturing gap". We have not here developed a way of quantifying this concept, but it would appear to exist for both Alberta and Canada as a whole. By the "primary-manufacturing gap" we mean the fact that although there is a very direct linkage effect between the extraction of a primary product and the industrial processes which make use of this primary product, the linkage effect is often felt outside the nation or the specific region concerned. The extraction of petroleum and natural gas within Alberta provides an example of this. There are very strong forward

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[8] Hirschman, p. 117.

links from this sector to the refining of petroleum products and the manufacture of industrial chemicals yet these industries are far larger in Ontario than in Alberta, as can be seen from looking at Tables 11 and 2. Other examples can easily be found for Alberta or Canada as a whole.

While it is difficult to generalize on the reasons for the "primary-manufacturing gap", some combination of the following locational factors is involved. Locational factors having to do with transportation undoubtedly play a large role. The example of the last paragraph, dealing with petroleum products, is also an example of this point. There is very little weight loss involved in the refining of petroleum products thus there is little incentive to process the petroleum near the source. In addition the costs of shipping crude oil by pipeline are undoubtedly less than the costs of shipping the various specific products of the refining process to the major Canadian market areas.

In this regard it is interesting to compare Alberta and British Columbia. With roughly 1.2 times the population of Alberta, British Columbia has 2.4 times the amount of industry as measured by total value added. The top three industries in British Columbia; sawmills and planning mills, pulp and paper mills, and veneer and plywood mills in 1967 represented a total value added of $559,390,000 while the total value added for all industries in Alberta for that year was $599,283,000. Much of this difference

between the two provinces can be explained as follows. The major products of Alberta lose very little weight in processing. Petroleum is in this category as are most agricultural products. Meat is an exception to this and is the industry in Alberta which contributes the most as measured by total value added. The main products of British Columbia on the other hand, such as the wood products from the industries mentioned above, do lose weight in processing. As a result more of this processing is done close to the source of the product. It would seem then that basic differences in natural resources between the two provinces have much to do with the amount of primary manufacturing in each.

Other factors also can be said to be, at least to some extent, the cause of the "primary-manufacturing gap". As we saw in chapter II, there are frequently external economies to be gained from locating in a larger population centre. Within Canada this works against the location of industry in Alberta. Related to this point are the forces which give rise to a tendency for an industry to locate close to its main market area. Such factors as the need for close contact with customers and distribution costs within the market area give rise to this tendency.

Another factor which may contribute to the existence of the "primary-manufacturing gap" is the tariff structure between Canada and its various trading partners. Traditionally

Canada has tried to get the easiest access possible for the raw materials she produces into other countries. This has been the case since the days of reciprocity in the 1850's, when agricultural products were given free access to the United States, to the present when Canada is bargaining for free access for petroleum products to the United States. While there are undoubtedly a great many other factors involved in a discussion of optimum tariff policy, policies which encourage the export of basic resources in as unmanufactured a state as possible do not encourage the development of primary and secondary manufacturing industry.

In summary then a much more comprehensive study of the linkage effects within the Canadian economy is needed. This study should delineate linkages much more clearly than we have been able to do here. Once this information is available much less general comments should be possible with respect to the attraction of industry to Alberta. It should be possible, for example to see which industries are not located here even though they are strongly linked to the existing Alberta economic structure. With this information much more could be done towards changing the locational factors causing these industries to locate elsewhere.

CHAPTER VII

A SUMMARY

The work done in this thesis is meant to make clear the position of the Province of Alberta with respect to the problem of attracting more manufacturing industries to within its boundaries. In clarifying this position we have dealt with a number of areas relating to the industrialization of Alberta.

In Chapter II several issues were raised relating to the goal of increased industrialization. It was pointed out that more manufacturing industry in Alberta does not necessarily imply a higher per capita income for Albertans, a more equal distribution of income within the province or an economy less sensitive to external economic forces. Mention was also made of the external diseconomies associated with increased industrialization.

In Chapter III we discussed two theories of regional economic growth as well as the traditional theory relating to the optimal location for an industrial plant. The Stages theory of regional growth, patterned after the European experience, and the North theory of regional growth were dealt with. The work of Chapter IV describing the Alberta economy made it quite clear that the North theory corresponds much more closely to development as it has occurred in Alberta than does the Stages theory.

A number of elements of location theory were dealt with in Chapter III. The three most important areas for Alberta would seem to be the theory relating to minimizing transportation costs, the theory relating to agglomeration of industry and the theory relating to optimally serving various types of market areas.

In Chapter IV the pattern of industrialization as it is in Alberta was studied. From this work several points become clear. First it became clear how greatly dependent industrialization in Alberta is upon the petroleum and agricultural base. We were able to roughly categorize the most important industries in Alberta into three groups; industries directly processing the natural resources, industries supplying inputs to the resource processors, and industries supply final demand to a population whose livelihood is largely dependent upon the natural resource base. Our analysis of the shifts in locational preference for various industries within Canada showed that Alberta is becoming increasingly dependent on natural resources for its expansion in primary and secondary manufacturing.

Two areas of discussion came out of the work done in Chapter IV. The first of these, the costs of transportation involved in moving goods to and from the major market areas and ports of Central Canada, is discussed in Chapter V. The most obvious conclusion to result from the work in

this chapter would be that the area of transportation costs is an immensely complex one. Even though we worked only with rail freight rates we were only able to discuss the basic structure of the rate schedule. Much work remains to be done in this area.

The other area of discussion arising from Chapter IV was related to the "linkages" existing in the Alberta economy. In Chapter VI we looked at work done to describe the linkage effects emanating from various industries within Canada. The work done here was of limited usefulness due to the amount of aggregation done in creating the input-output table used. It was found, however, that a majority of the most important industries in Alberta show above average linkage effects in one or both directions.

In conclusion we might rediscuss several areas which it appears would yield the most fruit to further study. Perhaps the most promising area would appear to be the further study of linkage effects in the economy of Alberta, Canada, and whole of North America. Further manufacturing industry is most likely to locate in the province if it can be "linked" to the existing structure as much as possible. It would seem most fruitful therefore to use the technique developed in Chapter VI to discover what the most obvious "gaps" in the Alberta industrial structure are.

Work might also be done in the related area of attempting to analyze the impact of investment in various industries on the manufacturing industries in Alberta. Both the Input-Output table for Canada and one in existence for the Alberta economy would be of value in this work. Comment on the extent to which investment in Alberta has impact outside of Alberta would be of value and might be possible from work done in this area.

A study of the whole area of transportation costs would seem fruitful. As we showed in Chapter V, the federal government has not been adverse to altering the rates for freight transportation to attempt to meet national goals. With further work it should be possible to better comment on the effect of the existing freight rate structure on the industrialization of Alberta. As well comment might be made on what sort of national freight rate policy would aid the Alberta governments in attracting more industry.

An area not dealt with at all here is the interaction of the Alberta economy with the United States and other countries. We have here largely considered Central Canada to be both the major market area and the major competitor for Alberta industry. We know however that many of the products of Alberta are sold in the United States and abroad, and much of the manufactured material used in Alberta comes from outside Canada. An application of work

done by Professor Wilkinson[1] for the Canadian economy to the Alberta economy would be of value. Tariff policy of Canada and our major trading partners no doubt has an effect on the amount of processing of natural resource products done before export.

Finally work should be done in the area of the relationship between tertiary and secondary industry. Many of the industries included in the tertiary sector of the economy would no doubt grow with growth in the amount of secondary industry. Such services as communications and financial services are likely examples of this. Other tertiary industries such as the tourist industry might decline with a growth in secondary industry. Further work should be done towards discovering more about these relationships as the tertiary sector is of growing importance in Alberta and throughout North America. It is also well to consider the possibility that greater returns might arise from policies designed to increase tertiary as opposed to secondary industry. It might be, for example, that the development of a research centre might be of more value in meeting our goals as cited in Chapter II than would the development of a new manufacturing plant.

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[1] B.W. Wilkinson, _Canada's International Trade: An Analysis of Recent Trends and Patterns_ (Montreal: The Private Planning Association of Canada, 1967).

Much work remains to be done in the area of this thesis. It is hoped however, that the initial work done here will clarify the problems involved in attracting more manufacturing industry to Alberta. As well it is hoped that a base is provided for further work in this area.

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APPENDIX A

TABLE 27

LIST OF THREE AND FOUR DIGIT MANUFACTURING INDUSTRIES[(a)]

Ind.Code	
	I. Food and Beverage Industries
101	Meat and Poultry Products Industries
1011	Slaughtering and Meat Processors
1012	Poultry Processors
102	Fish Products Industry
103	Fruit and Vegetable Processing Industries
1031	Fruit and Vegetable Canners and Preservers
1032	Frozen Fruit and Vegetable Processors
104	Dairy Products Industry
105	Flour and Breakfast Cereal Products Industry
106	Feed Industry
107	Bakery Products Industries
1071	Biscuit Manufacturers
1072	Bakeries
108	Miscellaneous Food Industries
1081	Confectionery Manufacturers
1082	Cane and Beet Sugar Processors
1083	Vegetable Oil Mills
1089	Miscellaneous Food Processors, n.e.s.
109	Beverage Industries
1091	Soft Drink Manufacturers
1092	Distilleries
1093	Breweries
1094	Wineries
	II. Tobacco Products Industries
151	Leaf Tobacco Processors
153	Tobacco Products Manufacturers
	III. Rubber and Plastics Products Industries
162	Rubber Products Industries
1623	Tire and Tube Manufacturers
1624	Rubber Footwear Manufacturers
1629	Miscellaneous Rubber Products Manufacturers
165	Plastics Fabricating Industry, n.e.s.

(Table 27, Continued)

IV. Leather Industries

172	Leather Tanneries
174	Shoe Factories
175	Leather Glove Factories
179	Luggage, Handbag and Small Leather Goods Manufacturers
1792	Boot and Shoe Findings Manufacturers
1799	Miscellaneous Leather Products Manufacturers

V. Textile Industries

181	Cotton Yarn and Cloth Mills
182	Wool Yarn and Cloth Mills
183	Man-Made Fibre, Yarn and Cloth Mills
184	Cordage and Twine Industry
185	Felt and Fibre Processing Mills
1851	Fibre Processing Mills
1852	Pressed and Punched Felt Mills
186	Carpet, Mat and Rug Industry
187	Canvas Products and Cotton and Jute Bags Industries
1871	Cotton and Jute Bags Manufacturers
1872	Canvas Products Manufacturers
188	Automobile Fabric Accessories Industry
189	Miscellaneous Textile Industries
1891	Thread Mills
1892	Narrow Fabric Mills
1893	Embroidery, Pleating and Hemstitching Manufacturers
1894	Textile Dyeing and Finishing Plants
1899	Miscellaneous Textile Industries, n.e.s.

VI. Knitting Mills

231	Hosiery Mills
239	Knitting Mills (except Hosiery Mills)

VII. Clothing Industries

243	Men's Clothing Industries
2431	Men's Clothing Factories
2432	Men's Clothing Contractors
244	Women's Clothing Industries
2441	Women's Clothing Factories
2442	Women's Clothing Contractors
245	Children's Clothing Industry
246	Fur Goods Industry
248	Foundation Garment Industry

(Table 27, continued)

249		Miscellaneous Clothing Industries
	2491	Fabric Glove Manufacturers
	2492	Hat and Cap Industry
	2499	Miscellaneous Clothing Industries, n.e.s.
		VIII. Wood Industries
251		Sawmills, Planing Mills and Shingle Mills
	2511	Shingle Mills
	2513	Sawmills and Planing Mills (except Shingle Mills)
252		Veneer and Plywood Mills
254		Sash, Door and Other Millwork Plants
	2541	Sash, Door and Other Millwork Plants, n.e.s.
	2542	Hardwood Flooring Plants
	2543	Manufacturers of Pre-fabricated Building (Wood-Frame Construction)
256		Wooden Box Factories
258		Coffin and Casket Industry
259		Miscellaneous Wood Industries
	2591	Wood Preservation Industry
	2592	Wood Handles and Turning Industry
	2593	Manufacturers of Particle Board
	2599	Miscellaneous Wood Industries, n.e.s.
		IX. Furniture and Fixture Industries
261		Household Furniture Manufacturers
	2611	Furniture Re-upholstery and Repair Shops
	2619	Household Furniture Manufacturers, n.e.s.
264		Office Furniture Manufacturers
266		Miscellaneous Furniture and Fixtures Manufacturers
268		Electric Lamp and Shade Manufacturers
		X. Paper and Allied Industries
271		Pulp and Paper Mills
272		Asphalt Roofing Manufacturers
273		Paper Box and Bag Manufacturers
	2731	Folding Carton and Set-up Box Manufacturers
	2732	Corrugated Box Manufacturers
	2733	Paper and Plastic Bag Manufacturers
274		Miscellaneous Paper Converters

(Table 27 continued)

	XI. Printing, Publishing and Allied Industries
286	Commercial Printing
287	Platemaking, Typesetting and Trade Bindery Industry
288	Publishing Only
289	Publishing and Printing
	XII. Primary Metal Industries
291	Iron and Steel Mills
292	Steel Pipe and Tube Mills
294	Iron Foundries
295	Smelting and Refining
296	Aluminum Rolling, Casting and Extruding
297	Copper and Copper Alloy Rolling, Casting and Extruding
298	Metal Rolling, Casting and Extruding, n.e.s.
	XIII. Metal Fabricating Industries (except Machinery and Transportation Equipment Industries)
301	Boiler and Plate Works
302	Fabricated Structural Metal Industry
303	Ornamental and Architectural Metal Industry
3031	Metal Door and Window Manufacturers
3039	Ornamental and Architectural Metal Industry, n.e.s.
304	Metal Stamping, Pressing and Coating Industry
3041	Metal Coating Industry
3042	Metal Stamping and Pressing Industry
305	Wire and Wire Products Manufacturers
306	Hardware, Tool and Cutlery Manufacturers
307	Heating Equipment Manufacturers
308	Machine Shops
309	Miscellaneous Metal Fabricating Industries
	XIV. Machinery Industries (except Electrical Machinery)
311	Agricultural Implement Industry
315	Miscellaneous Machinery and Equipment Manufacturers
316	Commercial Refrigeration and Air Conditioning Equipment Manufacturers
318	Office and Store Machinery Manufacturers

(Table 27, continued)

XV. Transportation Equipment Industries

321	Aircraft and Aircraft Parts Manufacturers
323	Motor Vehicle Manufacturers
324	Truck Body and Trailer Manufacturers
3241	Truck Body Manufacturers
3242	Non-Commercial Trailer Manufacturers
3243	Commercial Trailer Manufacturers
325	Motor Vehicle Parts and Acessories Manufacturers
326	Railroad Rolling Stock Industry
327	Shipbuilding and Repair
328	Boatbuilding and Repair
329	Miscellaneous Vehicle Manufacturers

XVI. Electrical Products Industries

331	Manufacturers of Small Electrical Applicances
332	Manufacturers of Major Appliances (Electric and Non-Electric)
333	Manufacturers of Lighting Fictures
334	Manufacturers of Household Radio and Television Receivers
335	Communications Equipment Manufacturers
336	Manufacturers of Electrical Industrial Equipment
338	Manufacturers of Electric Wire and Cable
339	Manufacturers of Miscellaneous Electrical Products
3391	Battery Manufacturers
3399	Manufacturers of Miscellaneous Electrical Products, n.e.s.

XVII. Non-Metallic Mineral Products Industries

351	Clay Products Manufacturers
3511	Clay Products Manufacturers (from domestic clays)
3512	Clay Products Manufacturers (from imported clays)
352	Cement Manufacturers
353	Stone Products Manufacturers
354	Concrete Products Manufacturers
3541	Concrete Pipe Manufacturers
3542	Manufacturers of Structural Concrete Products
3549	Concrete Products Manufacturers, n.e.s.
355	Ready-Mix Concrete Manufacturers
356	Glass and Glass Products Manufacturers
3561	Glass Manufacturers
3562	Glass Products Manufacturers
357	Abrasives Manufacturers
358	Lime Manufacturers
359	Miscellaneous Non-Metallic Mineral Products Industries
3591	Refractories Manufacturers
3599	Miscellaneous Non-Metallic Mineral Products Industries, n.e.s.

(Table 27, continued)

		XVIII. Petroleum and Coal Products Industries
365		Petroleum Refineries
	3651	Petroleum Refining
	3652	Manufacturers of Lubricating Oils and Greases
369		Miscellaneous Petroleum and Coal Products Industries
		XIX. Chemical and Chemical Products Industries
372		Manufacturers of Mixed Fertilizers
373		Manufacturers of Plastics and Synthetic Resins
374		Manufacturers of Pharmaceuticals and Medicines
375		Paint and Varnish Manufacturers
376		Manufacturers of Soap and Cleaning Compounds
377		Manufacturers of Toilet Preparations
378		Manufacturers of Industrial Chemicals
	3781	Manufacturers of Pigments and Dry Colours
	3782	Manufacturers of Industrial Chemicals (Inorganic), n.e.s.
	3783	Manufacturers of Industrial Chemicals (Organic), n.e.s.
379		Miscellaneous Chemical Industries
	3791	Manufacturers of Printing Inks
	3799	Miscellaneous Chemical Industries, n.e.s.
		XX. Miscellaneous Manufacturing Industries
391		Scientific and Professional Equipment Industries
	3911	Instrument and Related Products Manufacturers
	3912	Clock and Watch Manufacturers
	3913	Orthopaedic and Surgical Appliance Manufacturers
	3914	Ophthalmic Goods Manufacturers
	3915	Dental Laboratories
392		Jewellery and Silverware Industry
393		Sporting Goods and Toy Industries
	3931	Sporting Goods Manufacturers
	3932	Toys and Games Manufacturers
397		Signs and Displays Industry
399		Miscellaneous Manufacturing Industries, n.e.s.
	3991	Broom, Brush and Mop Manufacturers
	3992	Button, Buckle and Fastener Manufacturers
	3993	Floor Tile, Linoleum and Coated Fabrics Manufacturers
	3994	Sound Recording and Musical Instrument Manufacturers
	3995	Stamp and Stencil (Rubber and Metal)Manufacturers
	3996	Pen and Pencil Manufacturers
	3997	Typewriter Supplies Manufacturers
	3998	Fur Dressing and Dyeing
	3999	Other Miscellaneous Manufacturing Industries

(Table 27, continued)

(a) Source: Canada, Dominion Bureau of Statistics, *Standard Industrial Classification Manual*, 1970, p. 47-49.

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